RAS 14787

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
Lawrence G. McDade, Chairman
Dr. Richard E. Wardwell
Dr. Kaye D. Lathrop

DOCKETED
USNRC

December 11, 2007 (8:00am)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

In the matter of
ENTERGY NUCLEAR OPERATIONS, INC.
(Indian Point Nuclear Generating Units
2 and 3)

DOCKET NOS.
50-247-LR
50-286-LR
December 10, 2007

CONNECTICUT RESIDENTS OPPOSED TO RELICENSING OF INDIAN POINT AND ITS DESIGNATED REPRESENTATIVE'S
PETITION TO INTERVENE AND REQUEST FOR HEARING

Connecticut Residents Opposed to Relicensing of Indian Point ("CRORIP") and its designated representative, Nancy Burton, petition herewith to intervene in the proceedings before the U.S. Nuclear Regulatory Commission ("NRC") on the application of Entergy Nuclear Operations, Inc. ("Entergy") for relicensing of Indian Point Nuclear Generating Units 2 and 3 ("Indian Point") in accordance with the provisions of 10 CFR §2.309. Ms. Burton herewith petitions to intervene in her representative and in her individual capacity.

Standing

CRORIP and its designated representative, Nancy Burton, assert standing in this matter pursuant to 10 CFR Sections 2.309(d) and (e).

Connecticut Residents Opposed to Relicensing of Indian Point

Connecticut Residents Opposed to Relicensing of Indian Point ("CRORIP") is a grassroots coalition of organizations whose members reside in Connecticut and individuals who reside in Connecticut. The constituent organizations include People's Action for Clean Energy ("PACE"), the state's oldest all-volunteer safe-energy organization based in Canton, Connecticut; the Connecticut Chapter of the Sierra Club based in Hartford, Connecticut, a state chapter of the national organization whose mission is environmental protection; Don't Waste Connecticut, an organization devoted to education on safe energy issues based in New Haven, Connecticut; the Green Party of Connecticut; Connecticut Toxics Action Center, state chapter of the regional organization devoted to citizen action for a clean environment; Connecticut Citizens Awareness Network, a state chapter of the regional grassroots organization whose mission is to end the use of nuclear power in the Northeast and replace it with sustainable, reliable and affordable energy generation; and Connecticut Youth Activist Network, a statewide grassroots organization whose mission is to teach high school students to become active participants in the democratic process.

Individual members of CRORIP include:

David Bedell
12 Ardsley Road
Stamford CT 06906

Remy Chevalier
25 Newtown Turnpike
Weston CT 06883

Mitzi Bowman
97 Long Hill Terrace
New Haven CT06515

Lally Codriansky
1 Decatur Street

TEMPLATE = SECY-037

SECY-02

203-302-1977
Greenwich 06807

Gail Merrill
227 Silvermine Road
New Canaan CT 06842

Lucy Lee Grimes Evans
160 Old Kings Highway
New Canaan CT 06840

Paula Panzarella
70 Judson Avenue
New Haven CT 06511

Frank Panzarella
70 Judson Avenue
New Haven CT 06511

Nancy Burton
147 Cross Highway
Redding Ridge CT 06876

Many members of said constituent organizations and many individual members of CRORIP reside in Fairfield County, the entirety of which is located within the 50-mile radius of Indian Point, as illustrated in Entergy's License Renewal Application ("LRA"), Applicant's Environmental Report, Operating License Renewal Stage, at 2-37, Figure 2-8 at 2-103. The 2000 population of Fairfield County was 882,567 and projected to rise to 918,600 by the year 2035. Entergy Environmental Report, Operating License Renewal Stage at 2-37. Portions of New Haven County (2000 population 182,193, 2035 population 896,364) and Litchfield County (2000 population 182,193, 2035 population 217, 307) are also located within the 50-mile radius of Indian Point.

Attached hereto are Declarations of Nancy Burton of Redding, Connecticut, and Lally Codriansky, of Greenwich, Connecticut, and Gail Merrill of New Canaan, Connecticut, all individual members of CRORIP. All reside within 25 miles of Indian Point and share concerns about health and other risks from Indian Point threats they involuntarily assume by virtue of where they live. In their declarations, they particularize their concerns.

i. The name, address, telephone number, fax number and email address of the requestor or petitioner.

CRORIP's designated representative is:

Nancy Burton
147 Cross Highway
Redding Ridge CT 06876
Tel. 203-938-3952
NancyBurtonCT@aol.com

ii. The nature of requestor/petitioner's right under the Act to be made a party to the proceeding.

The petitioner, CRORIP, is comprised of residents of the State of Connecticut, many of whom reside in Fairfield County within 50 miles and downwind of Indian Point. As such, they are deemed by the U.S. Nuclear Regulatory Commission ("NRC") to be within the "peak injury zone" in the event of an unplanned radiological event at Indian Point and therefore subject to serious injury during the projected relicensing term.

As residents of the State of Connecticut, CRORIP's members' interests will not be protected in the proceedings other than through their own direct intervention and participation, notwithstanding that the RLA identifies Fairfield County and parts of New Haven County and Litchfield County as being within the "peak injury zone."

CRORIP's participation in these proceedings will therefore assist in developing a sound and complete record in this matter.

iii. The nature and extent of the requestor/petitioner's property, financial or other interest in the

proceeding.

CRORIP's constituent members all reside in the State of Connecticut, many with their family members, and many are owners of real estate in which they have substantial investments. Most obtain their livelihood in the State of Connecticut or in the New York metropolitan area within 50 miles or closer to Indian Point. Thereby, CRORIP's membership is within the zone of jeopardy from ill consequences of Indian Point operations during the projected relicensing term.

For example, CRORIP believes that the continued operation of Indian Point in the projected relicensing period will subject them to heightened risk of negative health effects, including life-threatening illness particularly among its most vulnerable members, the young and the elderly. Fairfield County is located to the east-northeast of Indian Point. The community of Greenwich is but 16 miles or less from Indian Point at its closest point. CRORIP intends to demonstrate through its expert, Joseph J. Mangano, M.P.H., that levels of strontium-90 in baby teeth of children born in Fairfield County are the highest in the New York metropolitan region, with the exception of the New York counties which are closest to Indian Point. Recent cancer incidence in Fairfield County is 8% and 7% above the U.S. rates for males and females. The section of Fairfield County with the highest cancer incidence rates are the towns in the southwest part of the county, downwind and closest to Indian Point. A statistical link has been established between high levels of strontium-90 in baby teeth and heightened risk of cancer incidence in the counties nearest Indian Point.

iv. The possible effect of any decision or order that may be issued in the proceeding on the requestor/petitioner's interest.

CRORIP's constituent members will suffer prejudice and the prospect of avoidable injury in the event orders are ultimately entered in this matter against their interests. CRORIP's members are legitimately concerned that their health and safety could be seriously compromised during the relicensing term because of increased risks of an accident or malevolent attack on Indian Point which could cause widespread and longlasting devastation of the entire state of Connecticut and beyond.

CRORIP has standing on its own behalf and on behalf of its members to request a hearing on the license renewal application. The Atomic Energy Act, 42 U.S.C. 2239(a)(1)(A) requires the NRC to provide a hearing "upon the request of any person whose interest may be affected by the proceeding."

In this matter, CRORIP is acting as a representative of its membership. An organization has standing to sue on behalf of its members when at least one member has standing to sue in his or her own right. The NRC has applied a standard in licensing proceedings that "persons who reside or frequent the area within a 50-mile radius of the facility" are presumed to have standing. Sequoyah Fuels Corp. and General Atomics, CLI-94-12, 40 NRC 64, 75.

The attached declaration of Lally Codrianksy states that she is a resident of Greenwich, Connecticut, which is the Connecticut town closest to Indian Point. Her particular interests are directly affected by the Indian Point relicensing. She has standing in her own right but she has authorized CRORIP to represents her interests in this proceeding. Accordingly, CRORIP has standing.

Nancy Burton

Nancy Burton ("Burton") owns and resides at property located at 147 Cross Highway, Redding Ridge, Connecticut, a location within 25 miles or less and downwind from Indian Point. She is petitioning both as the designated representative of CRORIP and in an individual capacity.

i. The name, address and telephone number of the requestor or petitioner.

Nancy Burton
147 Cross Highway
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ii. The nature of requestor/petitioner's right under the Act to be made a party to the proceeding.

Ms. Burton resides and earns her livelihood in Redding Ridge, Connecticut, 25 miles or less and downwind from Indian Point. As such, she is deemed by the U.S. Nuclear Regulatory Commission ("NRC") to be within the "peak injury zone" in the event of an unplanned radiological event at Indian Point and therefore subject to serious injury. As such, she has specific, personal and legal interests which will not otherwise be protected nor asserted in these proceedings other than through her direct intervention and participation. Her concerns are set forth in her attached declaration.

iii. The nature and extent of the requestor/petitioner's property, financial or other interest in the proceeding.

Ms. Burton resides in Fairfield County in the State of Connecticut, and is the owner with her husband, William H. Honan, of the property located at 147 Cross Highway in which she has a substantial investment.

As an occupant of property located 25 miles or less and downwind from Indian Point, Ms. Burton is subject to exposure to routine and accidental releases of radionuclides carried by wind activity from Indian Point to her home and environs.

iv. The possible effect of any decision or order that may be issued in the proceeding on the requestor/petitioner's interest.

Ms. Burton will suffer prejudice and the prospect of avoidable injury in the event orders are ultimately entered in this matter against her interests. A large-scale release of radioactivity in a catastrophic event, whether owing to mechanical failure, human error or an act of terrorism, would harm her by causing widespread devastation of the State of Connecticut.

Contentions

Pursuant to the provisions of 10 CFR §2.309(F)(3), CRORIP supports and adopts the contentions of the Attorney General of New York, Riverkeeper, Inc. and the Attorney General of Connecticut, all as filed on November 30, 2007, and the contentions of Hudson River Sloop Clearwater, Inc., PHASE and FUSE, Inc., all as filed on December 10, 2007.

CRORIP reserves the right to amend its contentions and add new contentions as the proceedings progress and as new information is disclosed.

Contention EC-1

Health risks from the cumulative effects of radiation exposure traceable to Indian Point routine and accidental releases during the projected relicensing term are substantial, have not been adequately accounted for in the RLA and constitute new information which must be but which has not been analyzed under 10 CFR Part 51.

(i) Provide a specific statement of the issue of law or fact to be raised or controverted.

Health risks from the cumulative effects of radiation exposure traceable to Indian Point routine and accidental releases during the projected relicensing term are substantial, have not been adequately accounted for in the RLA and constitute new information which should be but which has not been analyzed. The RLA dismisses these potential effects as being of only inconsequential ("small") concern, where they are of paramount concern to CRORIP membership and indeed all the communities in the environs of Indian Point and require consideration in these proceedings as a matter of law.

(ii) Provide a brief explanation of the basis of the contention.

Indian Point released 17.50 Curies of radiation to the atmosphere between 1970 and 1993, making it the fifth highest of 72 nuclear power stations then operating in the U.S., behind Dresden, Oyster Creek, Millstone and Quad Cities. (Tichler J. et al. Radioactive Materials Released from Nuclear Power Plants, annual reports. Brookhaven National Laboratory, Upton NY, NUREG/CR-2907) More recent data collected by the NRC demonstrates a six-fold increase in release of fission gases from fourth-quarter 2001 to 1st quarter 2002, about 100 times higher than 1st quarter 2001, including a 15-fold increase for Xenon-133. These facts provide a basis for concern about the potential releases of radiation during the projected relicensing period as the facility ages and cracks and leaks which have been detected currently inevitably worsen over time. Indeed, these facts also suggest an upward trending of radiological releases, contrary to the RLA, which asserts that radiological releases will continue at "current" levels. See Applicant's Environmental report, Operating License Renewal Stage, Section 4.23.3 ("Cumulative Radiological Impacts")("With respect to the future, the REMP sampling locations identified in the IP2 and IP3 ODCMs have not identified increasing levels or the accumulation of radioactivity in the environment over time.")

(iii) Demonstrate that the issue raised in the contention is within the scope of the proceeding.

The issue of the environmental and health consequences of radiation releases to the environment is clearly within the scope of this proceeding. In its Environmental Report, Appendix E, Entergy makes reference to the issue of its release of radiological materials to the environment in Sections 2.11.2 ("Radiological Environmental Monitoring Program Air Sampling Program"), 3.2.3 ("Radioactive Waste Treatment Processes (Gaseous, Liquid and Solid)") and in 4.23.3 ("Cumulative Radiological Impacts"). 10 CFR Part 51 requires an analysis of the environmental impact of these releases during the projected relicensing term.

(iv) Demonstrate that the issue raised in the contention is material to the findings the NRC must make to support the action that is involved in the proceeding.

Ultimately, the NRC must decide whether Indian Point can operate safely through the projected relicensing term without causing harm to the health and safety of the public. The petitioner submits that continued Indian Point operations beyond the current licensing period will subject the public to undue health and safety risks which have not been adequately analyzed.

The NRC's NUREG-1555, Supplement 1 is very specific about what the licensee is required to analyze with regard to radiological impacts of normal operations. See Section 4.3. Nevertheless, the RLA entirely omits data and information which is required regarding "new information on the radiological impacts of operation during the renewal term known to the applicant" as well as "new and potentially significant information on the impacts of renewal-term operations on radiological issues identified by the public." (Emphasis added.)

CRORIP contends that information regarding the credible statistical link between elevated levels of strontium-90 detected in baby teeth of children living in the region surrounding Indian Point and heightened cancer and associated disease incidence in the same region has been made public and brought to the attention of Entergy for a sufficient period of time to require its presentation in the application pursuant to the NUREG 1555, Supplement 1 passage quoted above, inter alia. This information is further developed in the Declaration of Joseph J. Mangano and his related report, "Public Health Risks to Fairfield County CT of Keeping the Indian Point Nuclear Reactors Open" (September 12, 2007), attachments hereto. Entergy's deliberate omission of this information requires admission of this contention.

(v) Provide a concise statement of the alleged facts or expert opinions which support the requestor/petitioner's position on the issue and on which the petitioner intends to rely at hearing, together with references to the specific sources and documents on which the requestor/petitioner intends to rely to support its position on the issue.

CRORIP presents facts supporting its contention through the Declaration of Joseph J. Mangano, MPH, MBA, Executive Director, Radiation and Public Health Project (attached) and his report titled "Public Health Risks to Fairfield County CT of Keeping the Indian Point Nuclear Reactors Open" (September 12, 2007)(attached), together with the sources cited by Mr. Mangano. The Declaration of Helen M. Caldicott, M.D. addressed to medical hazards of nuclear power generation is also attached hereto and incorporated herein.

In brief, a statistical link has been established between elevated levels of the fission product strontium-90 in baby teeth of children living near Indian Point and heightened incidences of cancer and related diseases in the same population. Heightened health risks from exposure to Indian Point-generated radiological releases – which are cumulative in effect in the human body - coupled with the inevitable progression of cracking and leaking as the facility ages lead to the conclusion that continued operation of Indian Point in the projected relicensing term cannot occur without undue and therefore unacceptable risk to the public health and safety.

(vi) Provide sufficient information to show that a genuine dispute exists with the applicant/licensee on a material issue of law or fact. This information must contain references to specific portions of the application (including the applicant's environmental report and safety report) that the petitioner disputes and the supporting reasons for each dispute, or, if the petitioner believes that the application fails to contain information on a relevant matter as required by law, the identification of each failure and the supporting reasons for the petitioner's belief.

Entergy's Environmental Report, Operating License Renewal Stage. Section 4.23.3 ("Cumulative Radiological Impacts") states in pertinent part:

On the basis of an evaluation of REMP [Radiological Environmental Monitoring Operating Reports] results, Entergy concludes that impacts of radiation exposure on the public and workers (occupational) from operation if IP2 and IP3 during the renewal term would be SMALL.. . . and therefore mitigation measures are not warranted.

CRORIP contends that Entergy failed to adequately evaluate the impact of its radiological releases on the public health during the projected relicensing term. In fact, the application is totally missing any analysis of the environmental impact of its radiation releases during the relicensing term on human health and on its own workforce.

Original Signed by Nancy Burton

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
Lawrence G. McDade, Chairman
Dr. Richard E. Wardwell
Dr. Kaye D. Lathrop
In the Matter of Docket Nos.
ENTERGY NUCLEAR OPERATIONS, INC. 50-247-LR and 50-286-LR
(Indian Point Nuclear Generating Units
2 and 3) December 10, 2007
CERTIFICATE OF SERVICE

I hereby certify that copies of the December 10, 2007 "CONNECTICUT RESIDENTS OPPOSED TO RELICENSING OF INDIAN POINT AND ITS DESIGNATED REPRESENTATIVE'S TO INTERVENE AND REQUEST FOR HEARING," Declarations of Joseph J. Mangano, M.P.H., Helen M. Caldicott, M.D., Nancy Burton, Gail Merrill and Lally Codriansky were served on this 10th day of December, 2007 upon the persons listed below, by first class mail and by email as shown below.

Original signed by Nancy Burton

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Attn: Adjudications and Rulemakings Staff
U.S. Nuclear Regulatory Commission

Office of Commission Appellate Adjudication
U.S. Nuclear Regulatory Commission

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UNITED STATES
NUCLEAR REGULATORY COMMISSION

In the matter of		
ENTERGY NUCLEAR INDIAN POINT 2, L.L.C., and	)	**License No. DPR-26**
ENTERGY NUCLEAR INDIAN POINT 3, L.L.C.	)	**License No. DPR-64**
Indian Point Energy Center Unit 2 and	)	**Docket No. 50-247**
Indian Point Energy Center Unit 3	)	**Docket No. 50-286**
License Renewal Application	)	

DECLARATION OF Joseph J. Mangano

My name is Joseph J. Mangano; I live in Ocean City NJ., 150 miles from Indian Point.

Connecticut Residents Opposed to Relicensing of Indian Point represents my interests in a Petition for Leave to Intervene, Request for Hearing and Contentions; and the Notice of Appearance, in the matter of Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC and Entergy Nuclear Operations, Inc., License Renewal Application.

I declare under penalty of perjury that the following statement is true and correct.

Executed this 30th day of November, 2007, at Ocean City, NJ.

Joseph J. Mangano

State of New Jersey

County of Cape May

On the 30th day of November, in the year 2007 before me, the undersigned, personally appeared Joseph J. Mangano, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her their signatures(s) on the instrument, the individual(s) or the person upon behalf of which the individual(s) acted, executed the instrument.

Joseph J. Mangano

Notary Public

STEPHANIE ELIZABETH KLEINOT
NOTARY PUBLIC
STATE OF NEW JERSEY
MY COMMISSION EXPIRES AUGUST 03, 2012

DECLARATION OF JOSEPH MANGANO

1. My name is Joseph Mangano. Connecticut Residents Opposed to Relicensing of Indian Point has retained me as a consultant with respect to the above-captioned proceeding. I am a health researcher, and have worked with the Radiation and Public Health Project (RPHP) since 1989. I currently serve RPHP as Executive Director.

My work with RPHP has involved conducting research on the risk of cancer and other disease from fission products emitted from nuclear reactors. To that end, I am the author or co-author of 23 medical journal articles that have been peer-reviewed by experts (unknown to me) and deemed appropriate for publication. I also am the author of *Low Level Radiation and Immune Damage: An Atomic Era Legacy* (Lewis 1998), and co-author of *The Enemy Within: The High Cost of Living Near Nuclear Reactors* (Four Walls Eight Windows, 1996).

For over a decade, our group has studied levels of radioactive Strontium-90 in baby teeth, based on prior studies in the 1960s in the U.S. and abroad. We have tested nearly 5,000 teeth in a laboratory, and five of the journal articles I mentioned address results of the tooth study. The effort is the only attempt to examine radioactivity levels in bodies of Americans living near nuclear reactors. My curriculum vitae is attached hereto as Attachment A.

2. I submit the following comments in support of the Connecticut Residents Opposed to Relicensing of Indian Point petition to intervene in the Indian Point relicensing proceedings.

3. Like all nuclear power reactors, Indian Point units 2 and 3 produce over 100 radioactive chemicals, or fission products, to generate electricity. Very few of these chemicals are found in nature, but are only produced in atomic bomb explosions and nuclear reactor operations. These chemicals, which are radioactive and known to cause cancer, include Cesium-137, Iodine-131, and Strontium-90.

4. Like all nuclear power reactors, Indian Point 2 and 3 emit radioactivity, in the form of gases and particles, into the air and water on a routine basis. Documentation of historical levels of these emissions is found in annual reports prepared for the Nuclear Regulatory Commission. The amount of airborne releases from Indian Point exceeds that of most other U.S. reactor, and can vary over time by a factor of 100 or more. (1) (2)

5. Indian Point has also experienced unplanned releases of radioactive chemicals into the environment, documented in the official reports of radioactive emissions and environmental levels. (1) (2)

6. State and federal regulatory agencies report environmental radioactivity levels near Indian Point, along with areas far from any nuclear reactor. The reports document that radioactivity levels are higher near Indian Point, and that there are large temporal

variations, both indicating that emissions from Indian Point are entering the air, water, and food in measurable quantities. (3) (4)

7. RPHP has measured levels of radioactive Strontium-90 (Sr-90) in a laboratory for nearly 5,000 baby teeth, over 500 of who are from children in the New York metropolitan area. Results, which are published in five medical journal articles, show that average Sr-90 levels near Indian Point are higher than any of the six nuclear plants with over 100 teeth studied, and that average levels near Indian Point have risen sharply since the late 1980s. (5)

The highest average Sr-90 is in the New York counties that flank Indian Point (Orange, Putnam, Rockland, and Westchester) at 3.78 picocuries of Sr-90 per gram of calcium at birth (279 teeth). The next highest area in the region was Fairfield County CT, which had an average of 3.45 (32 teeth), followed by the more distant New York City (3.10, 161 teeth) and Long Island (2.75, 94 teeth).

8. Hypotheses that low dose exposures to radioactivity are harmless to humans have been documented to be incorrect by scientific research. Nearly half a century ago, studies showing that pelvic X-rays to pregnant women raise the risk that the child will die of cancer by age ten, in both the United Kingdom and the United States, were the first to demonstrate carcinogenic effects of low dose exposures. (6) (7)

9. Other official reports that counter the prevailing assumption that low dose exposures are harmless include a 1997 report by the National Cancer Institute, which estimated that up to 212,000 Americans developed thyroid cancer from Iodine-131 in Nevada above-ground atomic tests, and a 2000 U.S. Department of Energy report concluding that many studies demonstrate elevated cancer risk for workers in nuclear weapons plants. (8) (9)

Several recent reports from a blue ribbon panel of experts on radiation health effects, the most recent in 2005, reviewed many scholarly reports on the topic, and determined that there is no safe threshold of radiation exposure, i.e., there are health risks from even the lowest doses. (10)

10. The youngest humans (fetus, infant, and young child) are more susceptible to the harmful properties of exposure to radioactive chemicals than are adults. (11)

11. Official public health statistics document elevated levels of cancer incidence in the counties closest to Indian Point, including Fairfield County CT. Cancer incidence for all Fairfield County residents for the period 1998-2002 was 8.2% and 6.7% higher than the U.S. rate for males and females, respectively, based on a total of 33,975 cases in the county. The elevated rates are statistically significant. (12) The portion of Fairfield County with the highest cancer incidence rate are the towns in the southwest part of the county, directly downwind and closest to Indian Point.

Mortality in Fairfield County from 1987-2004 was 5.6% below the U.S. for cancer (31,740), but 15.7% lower for all other causes (84,535 deaths), a statistically significant

difference. For children age 0-9, the gap was even greater: cancer mortality was 10.7% above the U.S. (79 deaths), while mortality for other causes was 25.8% lower (1691 deaths). (13)

The recent rate of babies born underweight in Fairfield County exceeds U.S. rates by 3%, 12%, 3%, and 32% for whites, blacks, Asians, and Hispanics, respectively. (14)

I incorporate by reference herein my report dated September 12, 2007 and entitled "Public Health Risk to Fairfield County of Keeping the Indian Point Nuclear Reactors Open."

12. RPHP has documented a statistical link between trends in average Sr-90 in baby teeth and trends in cancer incidence in children age 0-9 in Westchester, Rockland, and Putnam counties. Trends in Sr-90 were followed by similar trends in child cancer incidence four years later. Similar correlations were found in Ocean/Monmouth Counties in New Jersey (near the Oyster Creek nuclear reactor) and Suffolk County in New York (site of the Brookhaven reactors). (15)

13. A forthcoming medical journal article shows that of 14 U.S. nuclear plants started since 1982, the infant and fetal death rates rose most rapidly near the Grand Gulf plant in southwest Mississippi. The area near Grand Gulf has high (relative to the U.S.) proportions of African-American residents, and its poverty level is also high. The results suggest that poor minorities are more susceptible to the toxic properties of pollutants such as ionizing radiation. (16)

14. It is my opinion that the statistical link between trends in average Sr-90 levels in baby teeth and trends in cancer incidence in children age 0-9 in Westchester, Rockland, and Putnam counties referenced above in paragraph 12 provides scientific support for belief that radiation releases from Indian Point are responsible in part for both trends and that such trends will continue during the proposed relicensing period should Indian Point be allowed to continue to operate and release radiation to the environment at current levels.

REFERENCES

1. Tichler J., Doty K, Lucadamo K. Radioactive Materials Released from Nuclear Power Plants, annual reports. NUREG/CR-2907. Upton NY: Brookhaven National Laboratory. Latest volume covers annual airborne emissions of Iodine-131 and effluents, or isotopes with a half life over 8 days, for each U.S. reactor for each year from 1970-1993.

2. U.S. Nuclear Regulatory Commission, REIRS (spell out what REIRS stands for) www.reirs.com/effluent. Presents amounts of environmental radioactive releases, covering a variety of isotopes, for all U.S. nuclear reactors for each year from 2001-2004.

3. New York State Department of Health, Bureau of Radiation Protection. Environmental Radiation in New York State, annual volumes.

4. Annual Environmental Radiological Operating Report, Indian Point nuclear power plant, as reported to the U.S. Nuclear Regulatory Commission, www.nrc.gov.

5. Mangano JJ et al. An unexpected rise in strontium-90 in US deciduous teeth in the 1990s. The Science of the Total Environment 2003;317:37-51.

6. Stewart A et al. A survey of childhood malignancies. British Medical Journal 1958;i: 1495-1508.

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ATTACHMENT A

Joseph Mangano MPH MBA is a health researcher and Executive Director of the Radiation and Public Health Project (RPHP), which conducts research and education on health risks of nuclear reactors. Mr. Mangano has served RPHP since 1989. He has published 23 articles in medical journals that have been reviewed and approved for publication by experts. He is author of the book "Low Level Radiation and Immune System Damage: An Atomic Era Legacy" (Lewis 1998), and co-author of "The Enemy Within: The High Cost of Living Near Nuclear Reactors" (Four Walls Eight Windows 1996). His work has found a consistent pattern of increased cancer rates after nuclear reactors begun operating, and decreased rates after they shut down.

Mr. Mangano played a major role in the RPHP study of Strontium-90 in baby teeth, the only study ever to examine radioactivity levels in bodies of Americans living near nuclear plants. The study found the highest Sr-90 levels closest to plants, rising levels since the late 1980s, and high levels in children with cancer.

Mr. Mangano has participated in 20 press conferences and presented testimony to 17 government panels. He has also written 25 editorials in U.S. newspapers in 2006-2007, most of them discussing the health risks of building new nuclear reactors. Because of his efforts, RPHP work has been extensively covered by media including The New York Times, USA Today, CNN, NPR and BBC. He received master's degrees in public health from the University of North Carolina and in business administration from Fordham University.

EDITORIALS IN NEWSPAPERS (30): (* denotes letter, others are editorials)
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"French Fries Don't Give You Cancer" Pottstown (PA) Mercury, 2/14/05
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"Study Health of Neighbors of Millstone" New Haven (CT) Register, 5/23/06
"New South Texas Reactors: Build Them and Risks Will Come" Houston Chronicle, 7/22/06
"New Nuke Plants Hazardous to Amarillo's Health" Amarillo (TX) Globe-News, 8/18/06
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"Oyster Creek: Safety First" Trenton (NJ) Times, 9/28/07
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"State Should Look to Truly Clean Energy Sources" Milwaukee (WI) Journal Sentinel, 10/30/07
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"Demand Answers on Cancer Causes" Chattanooga (TN) Times Free Press, 11/25/07

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"Thyroid Cancer in the United States Since Accident at Chernobyl," *BMJ*, 8/19/95

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"Chernobyl Emissions Linked to a Variety of Adverse Health Effects in the U.S." In Kohnlein W and Nussbaum R (eds.): Effects of Low Dose Ionizing Radiation. Muenster, Germany: German Society for Radiation Protection, 1998.

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PRESS CONFERENCES (20):
- Washington DC, 4/00
- White Plains NY, 11/00 and 10/02
- Valhalla NY, 8/03
- Pottstown PA, 1/01, 11/03, 4/05, 5/06
- Toms River NJ, 5/00 and 4/01
- Mineola NY, 6/01
- New York City, 7/99, 4/02, and 11/07
- Trenton NJ, 5/03, 3/06, 6/07
- Hackensack NJ, 11/03
- Harrisburg PA, 8/04, 11/05

TESTIMONY TO GOVERNMENT OFFICIALS (17):
- New York State energy advisory group (NYSERDA), 4/02
- New York City Council (Indian Point NY plant), 5/02 and 2/03
- U.S. Nuclear Regulatory Commission (Harris NC plant), 7/07
- U.S. Nuclear Regulatory Commission (Oyster Creek NJ plant), 7/06, 5/07

- U.S. Nuclear Regulatory Commission (Peach Bottom PA plant), 7/02
- U.S. Nuclear Regulatory Commission (Turkey Point FL plant), 7/01
- Connecticut State utility commission, (Millstone CT plant) 11/00
- U.S. Senate Environment Committee (Sen. Hillary R. Clinton), 6/01
- Suffolk County (NY) legislature, Sr-90 in baby teeth, 8/00
- Suffolk County (NY) Rhabdomyosarcoma task force, 2001-3
- Westchester County (NY) legislature, Sr-90 in baby teeth 11/00, 10/02
- New Jersey Commission on Radiation Protection, 2/05, 6/07
- Ocean County (NJ) Board of Freeholders, 9/07

PUBLIC HEALTH RISKS TO FAIRFIELD COUNTY, CT OF KEEPING THE INDIAN POINT NUCLEAR REACTORS OPEN

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Executive Director
Radiation and Public Health Project
September 12, 2007

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EXECUTIVE SUMMARY

The Indian Point nuclear plant, 35 miles north of midtown Manhattan, has three reactors, two of which remain in operation. Entergy Nuclear, which operates the plant, has requested that the federal government extend the operating licenses of the two reactors for 20 additional years beyond their 2013 and 2015 expiration dates. To date, federal officials have not acknowledged any public health risks of license extension at Indian Point. This report explores risks from extending the Indian Point licenses.

Continued operation of Indian Point raises the risk of radioactivity exposure in two ways. First, the reactor cores would produce high-level waste to be added to the 1,500 tons already at the site, worsening the consequences of a large-scale release. Second, because reactors routinely release radioactivity, keeping Indian Point in service would mean greater releases and risks to local residents.

This report addresses the potential risks of keeping Indian Point operating for Fairfield County, CT. The county is located to the east-southeast of Indian Point, 16 miles away at its closest point in Greenwich and 45 miles away at its most distant in Stratford. The principal findings of this report are:

1. A large-scale release of radioactivity in a meltdown, from mechanical failure or act of sabotage, would harm thousands of Fairfield residents by radiation poisoning or cancer.

2. Indian Point has released the 5th greatest amount of airborne radioactivity out of 72 U.S. nuclear plants. In some periods, releases are up to 100 times greater than normal.

3. Levels of Strontium-90 in Fairfield County baby teeth are the highest in the New York metropolitan area, with the exception of the New York counties closest to Indian Point

4. The recent rate of babies born underweight in Fairfield County exceeds U.S. rates by 3%, 12%, 3%, and 32% for whites, blacks, Asians, and Hispanics

5. Recent cancer incidence in Fairfield County is 8% and 7% above the U.S. rate for males and females

6. The portion of Fairfield County with the highest cancer incidence rates are the towns in the southwest part of the county, directly downwind and closest to Indian Point

7. The Fairfield County death rate for children under age ten is 11% above the U.S. rate, but 26% below for all other causes.

While many factors contribute to cancer risk, evidence suggests that more detailed study on Indian Point is warranted, and that residents of Fairfield County be informed of any potential health risks, as federal regulators consider Entergy Nuclear's proposal to extend the Indian Point licenses for 20 years.

I. Introduction

A. Brief History of Nuclear Power and Indian Point. The discovery of nuclear fission, or creation of high energy by splitting uranium atoms, was first used for military purposes, i.e. the atomic bombs in Japan during World War II. Soon after, other uses of the fission process were introduced. One of these was the creation of electric power from the heat generated by fission. The "Atoms for Peace" speech given at the United Nations by President Dwight Eisenhower in 1953 opened the door for the development of reactors that would produce electricity.

Hundreds of reactors were proposed by electric utilities, who were interested based on the potential to produce clean and cheap energy. In the New York City area, many reactors were discussed, and federal applications were formally submitted for a total of 16 within 100 miles of midtown Manhattan. Of these, only five eventually operated and only three still remain in operation (Indian Point 2, Indian Point 3, and Oyster Creek).

The Indian Point plant is the former site of an amusement park in the town of Buchanan, in northwestern Westchester County. It is located on the Hudson River, the source of power needed to operate the plant. Five reactors were expected at the site; however, the Verplanck 1 and 2 reactors were cancelled in the 1970s, and the Indian Point 1 reactor closed permanently in 1974.

Indian Point 2 and 3 have the capacity to generate 951 and 965 megawatts of electricity, respectively, much more than the Indian Point 1 capacity of 257. The reactors went critical (began producing radioactivity) on May 22, 1973 and April 6, 1976, respectively. To date, no U.S. reactor has operated longer than 38 years, making the 34 and 31 year-old Indian Point reactors among the oldest.

B. Radioactivity Produced in Reactors. To produce electricity, nuclear power reactors split uranium-235 atoms, generating high energy that is transformed into electrical power. This splitting process, known as fission, also produces over 100 chemicals not found in nature. These chemicals are the same as those found in the large clouds of fallout after above-ground atomic bomb tests.

Fission products, which take the form of gases and particles, include Cesium-137, Iodine-131, and Strontium-90. They are highly unstable atoms which emit alpha particles, beta particles, or gamma rays. When they enter the body, they affect various organs. Cesium seeks out the muscles (including the heart and reproductive organs), iodine attacks the thyroid gland, and strontium attaches to bone. Each causes cancer after damaging DNA in cells and creating mutations, and is especially harmful to the fetus, infant, and child. Some decay quickly (Iodine-131 has a half life of 8 days), while others remain for long periods (Strontium-90 has a half life of 29 years).

Most of the radioactivity produced in reactors is contained within the reactor building and stored as high-level waste in deep pools of water that must be constantly cooled. At Indian Point and at other aging plants, the pools are becoming full. Some of the waste has been transferred to above-ground outdoor casks, and this process is expected to begin at Indian Point in late 2007. Indian Point currently maintains over 1,500 tons of waste on

site, and additional radioactivity in the reactor cores. The amount of radioactivity at the plant is equivalent to several Chernobyls, and hundreds of Hiroshima bombs.

The federal government has designated Yucca Mountain in Nevada as a permanent site for high level nuclear waste. Yucca has encountered much opposition, and will not open until at least 2018 (according to the U.S. Energy Department). Some experts believe that Yucca Mountain or any permanent repository will never open, leaving existing nuclear plants to maintain the waste indefinitely.

II. Health Hazards Posed by Reactor Meltdowns

A. Description. Much of the health concern posed by nuclear reactors is on the effects of a major meltdown. The radioactivity in a reactor core and waste pools must be constantly cooled by water, or the fuel will overheat, causing a huge release of radioactivity. This release can be caused by mechanical failure (such as what happened at Chernobyl in 1986) or by a deliberate act of sabotage.

Hiroshima and Nagasaki showed how high levels of radioactivity can harm humans. Those closest to the bombs were vaporized, literally melting from the intense heat. But many other victims who survived the blast developed acute radiation poisoning, marked by nausea, vomiting, diarrhea, skin burns, weakness, dehydration, bleeding, hair loss, ulcerations, bloody stool, and skin sloughing, according to the Medical Encyclopedia of the National Library of Medicine. A large number of bomb survivors also developed cancers over the next several decades; thyroid cancer had the greatest excess. (Source: Thompson DE et al. Cancer Incidence in Atomic Bomb Survivors. Part II: Solid Tumors, 1958-1987. Radiation Effects Research Foundation, Hiroshima Japan, 1994).

B. Estimates of Casualties. If a meltdown that caused large scale releases of radioactivity from the reactor core or the waste pools occurred at Indian Point, there would be no vaporizing of humans. However, many would suffer from acute radiation poisoning (short term) and cancer (long term). Several estimates have been made to calculate just how many would be harmed. In 1982, the Sandia National Laboratories submitted estimates to Congress for each U.S. nuclear plant (Indian Point estimates are in Table 1).

Table 1
Estimated Deaths/Cases of Acute Radiation Poisoning and Cancer Deaths
Near Indian Point, Following a Core Meltdown

Type of Effect	Indian Point 2	Indian Point 3
Deaths, Acute Radiation Poisoning	46,000	50,000
Cases, Acute Radiation Poisoning	141,000	167,000
Cancer Deaths	13,000	14,000

Note: Acute radiation poisoning cases/deaths calculated within 17.5 miles from the plant, cancer deaths within 50 miles from the plant. Source: Sandia National Laboratories, Calculation of Reactor Accident Consequences (CRAC-2) for U.S. Nuclear Power Plants. Prepared for U.S. Congress, Subcommittee on Oversight and Investigations, Committee on Interior and Insular Affairs. November 1, 1982.

The Sandia figures are known as CRAC-2 (for Calculation of Reactor Accident Consequences). CRAC-2 estimated casualties for Indian Point are one of the highest of

any U.S. nuclear plant. Many believe the figures should be much larger, since the local population has grown since 1982 when the calculations were made, and people beyond a 17.5 mile radius from the plant will also suffer adverse health consequences.

More recently, the Union of Concerned Scientists prepared an estimate of casualties after a core meltdown from a terrorist attack. The 2004 report entitled "Chernobyl on the Hudson" estimated much higher casualties than did the 1982 Sandia effort. The Union's Dr. Edwin Lyman calculated that as many as 44,000 near term deaths from acute radiation syndrome within 50 miles and 518,000 long term deaths from cancer within 60 miles could occur, depending on weather conditions. (Source: Lyman ES, Chernobyl on the Hudson?: The Health and Economic Impacts of a Terrorist Attack on the Indian Point Nuclear Plant." Washington DC: Union of Concerned Scientists, 2004. www.ucsusa.org).

Indian Point is more vulnerable to a meltdown from mechanical failure than most reactors because of its age, and more vulnerable to a terrorist attack due to its proximity to New York City. Since the terrorist attack on the World Trade Center of September 11, 2001, much attention has been paid to the Indian Point as a potential terrorist target.

The reactors are also more vulnerable to a meltdown due to its parts corroding as the plant ages and as the reactors operate much more of the time in recent years; the operating factor from 2001-2004 was 94.6% and 95.6% for the two reactors (average 95%), an increase from the pre-1995 factors of 64.7% and 50.4% (average 58%). Source: U.S. Nuclear Regulatory Commission, in The New York Times, October 2, 1995.

The potential for a meltdown, while not highly likely, is a reality. A recent report by Greenpeace entitled "An American Chernobyl" identified 200 near-miss accidents at American reactors in the past two decades, four at Indian Point, all since 2000 (Table 2).

Table 2
Near Miss Accidents At Indian Point Since 1986

Date	Reactor	Description
February 15, 2000	Indian Point 2	Steam generator tube rupture
July 19, 2002	Indian Point 2	Degraded control room fire barrier
August 14, 2003	Indian Point 2	Loss of offsite power due to NE blackout
August 14, 2003	Indian Point 3	Loss of offsite power due to NE blackout

Source: An American Chernobyl: Nuclear "Near Misses" at U.S. Reactors Since 1986. Washington DC: Greenpeace, 2006. www.greenpeace.org.

III. Radioactivity from Indian Point

A. Environmental Releases from Indian Point. All nuclear reactors must routinely emit radioactivity into the environment in order to operate. There are several forms of these emissions. One is accidental releases due to leaking equipment, which can include the cladding and welds of fuel rods in the reactor core, cracks and breaks in fuel that damages cladding, corroding pipes, and cracked steam generator tubes. These scenarios result in radioactivity released into the air and water. Radioactivity is also deliberately released into the local environment about every 18 months when reactors refuel.

Each utility is required by federal law to measure and report annual radioactive environmental emissions from nuclear reactors. From 1970-1993, the federal government produced a comparative listing of annual emissions for each U.S. reactor (it has since been discontinued). One measure of environmental emissions is known as airborne "Iodine-131 and Effluents" or chemicals with a half life of at least eight days (and thus, are more likely to enter the body through breathing and the food chain). The list of the U.S. nuclear plants with the highest releases is given in Table 3:

Table 3
U.S. Nuclear Plants with Highest Emissions of Airborne Radioactivity, 1970-1993

Plant	Location	Reactors	Emissions*
1. Dresden	Morris IL	3	97.22
2. Oyster Creek	Forked River NJ	1	77.05
3. Millstone	Waterford CT	2	32.80
4. Quad Cities	Cordova IL	2	26.95
5. Indian Point	**Buchanan NY**	**3**	**17.50**
6. Nine Mile Point	Scriba NY	2	14.67
7. Brunswick	Southport NC	2	14.50
8. Three Mile Island	Londonderry PA	2	14.43

* Curies of Iodine-131 and effluents Source: Tichler J et al. Radioactive Materials Released from Nuclear Power Plants, annual reports. Upton NY: Brookhaven National Laboratory, NUREG/CR-2907.

The Indian Point total of 17.50 curies is the 5th highest of 72 U.S. plants, greater than the 14.43 curies from the Three Mile Island plant in Pennsylvania. Most of the Indian Point total occurred in 1985 and 1986, with a total of 14.03 curies from Indian Point 2. Several years later, totals were changed to 1.90 curies; the U.S. Nuclear Regulatory Commission attributed the change to a "clerical error." While original figures are used here, revised figures would still rank Indian Point as the 12th highest in the nation.

More recent data on emissions is posted on the Internet by the federal government. Data for all U.S. reactors are listed from 2001-2004, by quarter, and by type of emission. No information for Indian Point 2 is given, and data for Indian Point 3 is incomplete. But examination of types of airborne and liquid radioactive emissions with complete data for each quarter from 2001-2004 from Indian Point 3 is helpful in understanding the large variations over time (Tables 4 and 5).

For example, fission gases rose about six-fold from 4th quarter 2001 to the 1st quarter 2002 (about 15-fold for Xenon-133), about 100 times higher than 1st quarter 2001. Second quarter 2004 airborne fission gases were much higher than typical 2003 releases. More analysis is needed to understand reason(s) for these releases. But it is clear that there are very large swings in emissions levels over time.

Table 4
Airborne Radioactivity Released from Indian Point 3, in Millicuries by Quarter, 2001-04

Quarter	Xenon-133	Tot. Fission Gases	Tritium
1st Q 01	59	91	360
2nd Q 01	218	251	457
3rd Q 01	321	1040	1120
4th Q 01	378	1400	1430
1st Q 02	5580	8180	1310
2nd Q 02	1820	3790	1670
3rd Q 02	166	202	1540
4th Q 02	33	55	679
1st Q 03	141	181	495
2nd Q 03	190	229	828
3rd Q 03	371	525	951
4th Q 03	523	1590	830
1st Q 04	144	204	1420
2nd Q 04	1290	1450	1340
3rd Q 04	29	58	1140
4th Q 04	36	121	1570

One millicurie is 1/1000th of a curie. The physical half lives of Xenon-133 and Tritium are 5.24 days and 12.3 years, respectively. Source: U.S. Nuclear Regulatory Commission. www.reirs.com/effluent/EDB

Table 5
Liquid Radioactivity Released from Indian Point 3, in Millicuries by Quarter, 2001-04

Quarter	Fission/Activation Products	Tritium
1st Q 01	27.0	251,000
2nd Q 01	51.4	170,000
3rd Q 01	36.4	22,900
4th Q 01	12.0	482,000
1st Q 02	4.5	31,900
2nd Q 02	2.5	19,600
3rd Q 02	7.6	51,400
4th Q 02	14.0	692,000
1st Q 03	3.9	667,000
2nd Q 03	27.3	61,800
3rd Q 03	7.5	187,000
4th Q 03	6.3	38,500
1st Q 04	3.1	28,800
2nd Q 04	3.0	71,800
3rd Q 04	4.7	44,900
4th Q 04	4.8	530,000

One millicurie is 1/1000th of a curie. The physical half life of Tritium is 12.3 years. Source: U.S. Nuclear Regulatory Commission. www.reirs.com/effluent/EDB

B. Radioactivity Levels in Bodies near Indian Point. The question of how much man-made radioactivity enters human bodies was first considered in the 1950s, when the U.S. government sponsored studies that measured bone and teeth samples for Strontium-90, one of the 100-plus chemicals found in nuclear weapon explosions and nuclear reactor

operations. A landmark study of baby teeth in St. Louis found that the average Sr-90 level for children born in 1964 (just as atomic bomb testing was stopped) was about 50 times greater than for children born in 1950. Furthermore, Sr-90 studies found that average concentrations in bodies plunged by about half from 1964 to 1969, after large-scale weapons testing in the atmosphere was banned. Similar studies of Sr-90 in bone and teeth in Europe found similar patterns. (Sources: Rosenthal HR. Accumulation of environmental strontium-90 in teeth of children. In: Proceedings of the Ninth Annual Hanford Biology Symposium, Richland WA, May 5-8, 1969. Washington DC: U.S. Atomic Energy Commission, 1969. Health and Safety Laboratory, U.S.Atomic Energy Commission. Strontium-90 in Human Vertebrae. In: Radiation Data and Reports, monthly volumes, 1964-1969).

Government officials dropped their in-body radiation monitoring programs in 1970, 1971, and 1982. No studies measuring in-body levels near U.S. nuclear plants existed until 1996, when the independent research group Radiation and Public Health Project initiated an effort measuring Sr-90 in baby teeth. RPHP used a machine designed to measure low-dose radioactivity levels and selected the REMS radiochemistry lab of Canada to establish protocols and test teeth.

The lab calculated the ratio of Sr-90 to calcium, and RPHP converted it to a ratio at birth, using the Sr-90 half life of 28.7 years. Most Sr-90 in a baby tooth is taken up during the last six months of pregnancy and the first few months of life. A tooth from a person age 28.7 years with a current ratio of 4.30 would have an at-birth ratio of 8.60. Teeth were classified according to where the mother lived during pregnancy and the first year of life, not the current residence.

RPHP has tested nearly 5,000 baby teeth, and published five medical journal articles on results. Average Sr-90 in baby teeth was 30-50% higher in counties closest to six U.S. nuclear plants, and rose about 50% from the late 1980s to the late 1990s (reversing a prior decline), as reactors aged and were in operation more frequently. Results were statistically significant, suggesting strongly that reactor emissions were entering human bodies. (Source: Mangano JJ et al. An unexpected rise in Strontium-90 in US deciduous teeth in the 1990s. The Science of the Total Environment 2003;317:37-51).

Over 500 teeth were collected and tested from the New York metropolitan area partly supported by a $25,000 grant from the Westchester County legislature. The average local Sr-90 level was highest in the four New York counties closest to Indian Point – Westchester, Rockland, Orange, and Putnam (3.78 picocuries per gram of calcium), followed closely by Fairfield County CT (3.45). The average in Fairfield exceeded both New York City and Long Island (Table 6).

Table 6
Average Strontium-90 in Baby Teeth, New York Metropolitan Area

Region	Teeth	Average Sr-90
4 NY Cos. Near Indian Point	279	3.78
Fairfield County	32	3.45
New York City	161	3.10
Long Island	94	2.75

Average = picocuries of Sr-90 per gram of calcium at birth. Only births after 1979 included.
Source: Radiation and Public Health Project

While the tooth study provided some unique and important data, it is difficult to demonstrate exactly how the Sr-90 entered children's bodies. (Some is from the mother's bone stores, some through the mother's diet during pregnancy, and some through the baby's diet during infancy). Sr-90 enters bodies through milk, water, vegetation, and breathing. These limits do not, however, negate the importance of consistent and significant findings of high and rising levels of radioactivity closest to Indian Point.

IV. Potential Health Risks from Indian Point in Fairfield County

A. Rises in Connecticut Childhood Cancer. Evidence suggests that exposure to fission products may have increased the risk of cancer in Connecticut – especially in children, who are most susceptible to radiation. Historical data shows that cancer in the youngest children – which most likely reflects harm during pregnancy – rose during above ground atomic bomb tests, and when nuclear reactors in and near the state operated.

Atmospheric nuclear weapons tests began in 1946 and ended in 1963. Connecticut cancer incidence age 0-4 from the late 1940s to the early 1960s rose from 14.86 to 19.37 cases per 100,000, up 30.3%. From 1967-1975, an additional five nuclear reactors in or near Connecticut began operating, two at Millstone, one at Connecticut Yankee, and two at Indian Point. Cancer incidence age 0-4 in the state rose from 15.28 to 23.13 cases per 100,000 from the late 1960s to the late 1990s, up 51.4% (Table 7).

Table 7
Conn. Cancer Incidence 0-4 During Bomb Tests/Reactor Operations, by 4-Year Periods

	Period of Bomb Testing			Period of Reactor Operations			
Period	Cases	Pop.	Rate	Period	Cases	Pop.	Rate
1945-48	105	706,630	14.86	1967-70	159	1,040,253	15.28
1949-52	139	803,118	17.31	1971-74	159	934,719	17.01
1953-56	155	921,131	16.83	1975-78	154	762,114	20.21
1957-60	175	1,082,820	16.16	1979-82	120	755,805	15.88
1961-64	217	1,120,124	19.37	1983-86	178	819,734	21.71
				1987-90	192	911,497	21.06
				1991-94	197	942,986	20.89
				1995-98	202	873,425	23.13

Source: Connecticut Tumor Registry

B. Fairfield County as a Low-Risk Area. Fairfield County CT is located to the east-southeast of Indian Point, 16 miles away at its closest point in Greenwich and 45 miles away at its most distant in Stratford, making it the closest county in the state to Indian Point. The current county population is just over 900,000. It consists of 23 cities and towns, the largest of which are Bridgeport, Stamford, and Norwalk.

Fairfield County is not at apparent risk for health problems. Its population is better educated, has a higher income level, and has a lower unemployment rate than the nation, suggesting healthier living conditions and better health practices (Table 8). In addition to adequate financial access to medical care, Fairfield's location close to New York City gives its residents access to world class medical care.

Table 8
Demographic Comparison, Fairfield County vs. U.S.

Characteristic	Fairfield	United States
2006 Estimated population	900,440	299,398,484
2005 % Black	10.7	12.8
2005 % Hispanic	14.0	14.4
2005 % Asian	4.1	4.3
2000 % Foreign Born	16.9	14.4
2000 % HS grad > 25	84.4	80.4
2000 % Coll grad > 25	39.9	24.4
2000 % w Disability >5	16.0	19.0
2004 Median Household Inc	$60,790	$44,334
2004 % Below poverty	8.5	12.7
2006 % Unemployment	3.8	4.6

Sources: U.S. Department of Agriculture, www.ers.usda.gov/data/unemployment (for unemployment). U.S. Census Bureau, www.census.gov, state and county quick facts (all other data).

C. Low Weight Births. As mentioned, the fetus and infant are most sensitive to the toxic effects of radiation exposure. The infant mortality rate in Fairfield County is below the national rate, as advances in medical treatment (most available to the affluent) save more lives than ever before. However, the healthy development of the fetus is not as likely to reflect medical treatment. Table 8 shows that in recent years, the rate of Fairfield County babies born at very low weight (under 3.3 pounds) exceeds the U.S. rate by 3%, 12%, 3%, and 32% for whites, blacks, Asians, and Hispanics.

Table 8
Underweight Births by Race, Fairfield County vs. U.S., 1996-2002

	Live Births		Rate/100 Births		
Race	<3.3 lbs.	Total	County	U.S.	% Co. vs. U.S.
Whites	839	71538	1.17	1.14	**+ 2.6%**
Blacks	375	10862	3.45	3.07	**+12.4%**
Asian	43	3953	1.09	1.06	**+ 2.8%**
Am. Indian	4	138	2.90	1.12	-----
TOTAL	1261	86491	1.46	1.43	**+ 2.1%**
(Hispanic	215	14379	1.51	1.14	**+32.4%**)

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov, births. Excludes births with no stated weight. 3.3 pounds equals 1500 grams. Hispanics are can be in any racial group.

C. Cancer Incidence. The Connecticut Tumor Registry began in 1935, making it the oldest in the United States. Table 9 compares recent (1998-2002) incidence of all cancers combined in Fairfield County with the U.S. The county rate is 8% and 7% above the U.S. for males and females, respectively. A total of 33,975 cancer cases were diagnosed among county residents during the five-year period.

Table 9
Cancer Incidence, Fairfield County vs. U.S., 1998-2002

	Fairfield County			
Area	Cases	Cases/100000	U.S. Cases/100000	% Co. vs. U.S.
Males	12222	613.4	567.0	**+8.2%**
Females	11753	450.2	421.9	**+6.7%**

Source: Connecticut Tumor Registry, Department of Public Health, www.state.ct.us (Connecticut data). Surveillance Epidemiology and End Results system, www.seer.cancer.gov (U.S. data, nine states and cities representing 10% of U.S. population, including Connecticut).

One of the most radiation-sensitive types of cancer is breast cancer in women. Breast cancer incidence has soared during the past two decades in the U.S., including in Connecticut. The 1998-2002 breast cancer incidence rate in Fairfield County is 6% higher than the U.S. rate (145.8 vs. 137.1 per 100,000). Nearly 800 Fairfield County women are diagnosed with the disease each year.

Within Fairfield County, there are variations in cancer incidence. Rates for the 12 cities and towns closest to Indian Point (and southeast, or directly downwind of prevailing winds during the colder months) were compared with those for the 11 more distant cities and towns. The most recent data available are from 1995-1999 (Table 10).

For all cancers, incidence for the 3.6% below the state rate for the 12 closest towns, but 7.7% below for the other towns. For breast cancer, the rate for the 12 closest towns equaled the state rate, but was 13.4% lower for the other towns. Differences are significant, and excess cancer cases in the five years equal 554 (all) and 327 (breast).

Table 10
Incidence, All Cancers and Female Breast Cancer, By Area of Fairfield County, 1995-99

Area of County	Cases, 1995-99 Actual	Expected*	% Above/Below CT
All Cancers			
Twelve Towns Nearest Indian Point	12940	13420	**- 3.6%**
Other Fairfield County	8141	8817	**- 7.7%**
Female Breast Cancer			
Twelve Towns Nearest Indian Point	2097	2094	**+ 0.0%**
Other Fairfield County	1224	1413	**- 13.4%**

* Expected cases if local rate equaled state rate. For all cancers, difference is significant ($p<.001$); excess cases = 554. For breast cancer, difference is significant ($p<.001$); excess cases = 327. Twelve towns are Darien, Easton, Fairfield, Greenwich, New Canaan, Norwalk, Ridgefield, Stamford, Trumbull, Weston, Westport, and Wilton. Source: Incidence of Selected Cancers in Connecticut by Town 1995-99, www.dph.state.ct.us/OPPE/hptumor.htm.

D. Cancer Mortality. The type of cancer most extensively studied for risks of radiation exposure is childhood cancer. In the past two decades, the rate of Fairfield County children under ten who died of cancer was 10.7% above the U.S. rate. This compares to a local rate 25.8% below the U.S. for all other causes for children under ten (Table 11).

Table 11
Mortality Rates, Cancer/Other Causes, Age 0-9, Fairfield County vs. U.S., 1987-2004

Area	Deaths	Ann Pop	Rate	% Co. vs. U.S.
Cancer				
Fairfield County	79	120903	3.63	**+10.7%**
United States	22760	38563621	3.28	
All Other Causes				
Fairfield County	1691	120903	77.70	**- 25.8%**
United States	726815	38563621	104.71	

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov, underlying cause of death. Uses ICD-9 cancer codes 140.0-239.9 (before 1999) and ICD-10 cancer codes C00-D48.9 (1999 and after). Difference significant at $p<.05$.

The gap between deaths from cancer and other causes in Fairfield County also exists for persons of all ages. In the past two decades, the county death rate from cancer was 5.6% below the U.S., but 15.7% below for all other causes. From 1987-2004, 31,740 Fairfield County residents died of cancer (Table 12).

Table 12
Mortality, Cancer/Other Causes, All Ages, Fairfield County vs. U.S., 1987-2004

Area	Deaths	Ann Pop	Rate	% Co. vs. U.S.
Cancer				
Fairfield County	31740	857942	196.7	**- 5.6%**
United States	9714422	267709000	208.3	
All Causes Excluding Cancer				
Fairfield County	84535	857942	589.6	**- 15.7%**
United States	31547295	267709000	699.5	

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov, underlying cause of death. Uses ICD-9 cancer codes 140.0-239.9 (before 1999) and ICD-10 cancer codes C00-D48.9 (1999 and after). Rates adjusted to 2000 U.S. standard population. Difference significant at $p<.0001$. Excess number of cases equals 3174.

V. Studies of improved local health after reactor shutdown

A. Precedent – Atomic Bomb Test Halt. If Indian Point closes, no more radioactivity will be produced or released from the reactor core, even though the slow-decaying forms of radioactive waste will remain at the plant. Closing the reactor will reduce levels of these products in the environment and body. When above ground atomic bomb tests ceased, chemicals that decay quickly (such as Iodine-131, with a half life of eight days) virtually disappeared. Chemicals with a slower decay rate also dropped; Strontium-90 fell 75% in milk and 50% in bones from 1964-1970. (Source: Health and Safety Laboratory, U.S. Atomic Energy Commission. In: Radiation Data and Reports, monthly volumes, 1964-1970).

Reduced environmental radioactivity raises the question of whether disease rates also decline, especially among the more susceptible infant and children. Cancer incidence age 0-4 in Connecticut rose as large-scale bomb testing continued; from 1959 to 1962, new cases increased steadily from 41 to 60. But after testing ended, cases plunged, from 60 to 30 between 1962 and 1968 (Table 13). Cancer incidence to young children can be seen as one of the most sensitive indicators of harm from radiation exposure.

Table 13
Annual Cancer Cases Diagnosed in Connecticut Children Age 0-4, 1959-1968

Year	Cases	Year	Cases
During Bomb Testing		After Bomb Testing	
1959	41	1964	53
1960	47	1965	38
1961	46	1966	43
1962	60	1967	43
1963	58	1968	30

Source: National Cancer Institute, Forty-five Years of Cancer Incidence in Connecticut: 1935-79. NIH Publication No. 86-2652. Bethesda MD: U.S. Department of Health and Human Services, 1986.

B. Precedent – Nuclear Reactor Closing. Most radioactivity in the core of a nuclear reactor consists of chemicals that decay relatively quickly. A recent report calculated that a core meltdown just 20 days after shutdown of a fully operational reactor would mean 50% fewer cancer deaths and 81% fewer acute radiation deaths within 50 miles. Source: Lyman ES. The Impact of Nuclear Plant Shutdown on Severe Accident Consequences. Washington DC: Nuclear Control Institute, February 12, 2002.

Like atomic bomb test cessation, there may be a precedent for cancer reductions after nuclear reactors close and radioactive releases end. A 2002 journal article by the Radiation and Public Health Project examines downwind areas near reactors that closed from 1987-1998 that were at least 70 miles from any other nuclear plant. Cancer incidence age 0-4 fell near each plant (total of -24.8%), even though there was a slight increase in U.S. childhood cancer during this period (Table 14).

Table 14
Change in Cancer Incidence, Age 0-4, Before and After Reactor Closing
Counties Downwind and <40 Miles of Closed Reactors

Reactor	Year Closed	Counties Downwind and <40 Miles
LaCrosse	1987	LaCrosse, Vernon WI
Rancho Seco	1989	Amador, El Dorado, Placer, Sacramento CA
Fort St. Vrain	1989	Larimer, Weld CO
Big Rock Point	1997	Antrim, Charlevoix, Cheboygan, Emmet, Otsego MI
Maine Yankee	1997	Kennebec, Knox, Lincoln ME
Zion	1998	Lake IL; Kenosha, Racine WI

	Before	After	Cases/100,000 (No.)		
Reactor	Close	Close	Before	After	% Change
LaCrosse	'86-87	'88-94	40.0 (7)	24.6 (15)	**-38.5%**
Rancho Seco	'88-89	'90-96	24.0 (50)	17.6 (153)	**-26.9%**
Fort St. Vrain	'88-89	'90-96	20.3 (10)	18.0 (32)	**-11.7%**
Big Rock Pt.	'96-97	'98-00	45.0 (7)	21.1 (5)	**-53.1%**
Me. Yankee	'96-97	'98-01	38.1 (8)	27.2 (11)	**-28.5%**
Zion	'97-98	'99-00	21.2 (32)	19.7 (30)	**- 7.0%**
TOTAL			24.7 (114)	18.5 (246)	**-24.8%**
U.S. ANNUAL AVERAGE CHANGE, 1986-1998					**+ 0.3%**

Sources: State cancer registries, in Mangano JJ et al. Infant Death and Childhood Cancer Reductions after Nuclear Plant Closings in the United States. Archives of Environmental Health 2002;57(10):23-32.

C. Potential Cancer Reductions After Indian Point Closing. There are potential implications of these historical trends for Fairfield County if Indian Point were to cease operating. County rates of low weight births, cancer incidence, and cancer mortality often exceed the national rate, even though there are no obvious local risk factors. With about 4,000 and 2,000 Fairfield county residents being diagnosed with and dying of cancer each year, reduced exposures to radioactive chemicals could reduce those with cancer by hundreds each year. Such a change would be of great benefit to society, as it

would save the enormous direct medical costs of treatment, and would allow more members of society to function productively. These risks should be considered in contrast with other forms of electricity that do not pollute, such as solar and wind power.

PUBLIC HEALTH RISKS TO FAIRFIELD COUNTY, CT OF KEEPING THE INDIAN POINT NUCLEAR REACTORS OPEN

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September 12, 2007

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EXECUTIVE SUMMARY

The Indian Point nuclear plant, 35 miles north of midtown Manhattan, has three reactors, two of which remain in operation. Entergy Nuclear, which operates the plant, has requested that the federal government extend the operating licenses of the two reactors for 20 additional years beyond their 2013 and 2015 expiration dates. To date, federal officials have not acknowledged any public health risks of license extension at Indian Point. This report explores risks from extending the Indian Point licenses.

Continued operation of Indian Point raises the risk of radioactivity exposure in two ways. First, the reactor cores would produce high-level waste to be added to the 1,500 tons already at the site, worsening the consequences of a large-scale release. Second, because reactors routinely release radioactivity, keeping Indian Point in service would mean greater releases and risks to local residents.

This report addresses the potential risks of keeping Indian Point operating for Fairfield County, CT. The county is located to the east-southeast of Indian Point, 16 miles away at its closest point in Greenwich and 45 miles away at its most distant in Stratford. The principal findings of this report are:

1. A large-scale release of radioactivity in a meltdown, from mechanical failure or act of sabotage, would harm thousands of Fairfield residents by radiation poisoning or cancer.

2. Indian Point has released the 5th greatest amount of airborne radioactivity out of 72 U.S. nuclear plants. In some periods, releases are up to 100 times greater than normal.

3. Levels of Strontium-90 in Fairfield County baby teeth are the highest in the New York metropolitan area, with the exception of the New York counties closest to Indian Point

4. The recent rate of babies born underweight in Fairfield County exceeds U.S. rates by 3%, 12%, 3%, and 32% for whites, blacks, Asians, and Hispanics

5. Recent cancer incidence in Fairfield County is 8% and 7% above the U.S. rate for males and females

6. The portion of Fairfield County with the highest cancer incidence rates are the towns in the southwest part of the county, directly downwind and closest to Indian Point

7. The Fairfield County death rate for children under age ten is 11% above the U.S. rate, but 26% below for all other causes.

While many factors contribute to cancer risk, evidence suggests that more detailed study on Indian Point is warranted, and that residents of Fairfield County be informed of any potential health risks, as federal regulators consider Entergy Nuclear's proposal to extend the Indian Point licenses for 20 years.

I. Introduction

A. Brief History of Nuclear Power and Indian Point. The discovery of nuclear fission, or creation of high energy by splitting uranium atoms, was first used for military purposes, i.e. the atomic bombs in Japan during World War II. Soon after, other uses of the fission process were introduced. One of these was the creation of electric power from the heat generated by fission. The "Atoms for Peace" speech given at the United Nations by President Dwight Eisenhower in 1953 opened the door for the development of reactors that would produce electricity.

Hundreds of reactors were proposed by electric utilities, who were interested based on the potential to produce clean and cheap energy. In the New York City area, many reactors were discussed, and federal applications were formally submitted for a total of 16 within 100 miles of midtown Manhattan. Of these, only five eventually operated and only three still remain in operation (Indian Point 2, Indian Point 3, and Oyster Creek).

The Indian Point plant is the former site of an amusement park in the town of Buchanan, in northwestern Westchester County. It is located on the Hudson River, the source of power needed to operate the plant. Five reactors were expected at the site; however, the Verplanck 1 and 2 reactors were cancelled in the 1970s, and the Indian Point 1 reactor closed permanently in 1974.

Indian Point 2 and 3 have the capacity to generate 951 and 965 megawatts of electricity, respectively, much more than the Indian Point 1 capacity of 257. The reactors went critical (began producing radioactivity) on May 22, 1973 and April 6, 1976, respectively. To date, no U.S. reactor has operated longer than 38 years, making the 34 and 31 year-old Indian Point reactors among the oldest.

B. Radioactivity Produced in Reactors. To produce electricity, nuclear power reactors split uranium-235 atoms, generating high energy that is transformed into electrical power. This splitting process, known as fission, also produces over 100 chemicals not found in nature. These chemicals are the same as those found in the large clouds of fallout after above-ground atomic bomb tests.

Fission products, which take the form of gases and particles, include Cesium-137, Iodine-131, and Strontium-90. They are highly unstable atoms which emit alpha particles, beta particles, or gamma rays. When they enter the body, they affect various organs. Cesium seeks out the muscles (including the heart and reproductive organs), iodine attacks the thyroid gland, and strontium attaches to bone. Each causes cancer after damaging DNA in cells and creating mutations, and is especially harmful to the fetus, infant, and child. Some decay quickly (Iodine-131 has a half life of 8 days), while others remain for long periods (Strontium-90 has a half life of 29 years).

Most of the radioactivity produced in reactors is contained within the reactor building and stored as high-level waste in deep pools of water that must be constantly cooled. At Indian Point and at other aging plants, the pools are becoming full. Some of the waste has been transferred to above-ground outdoor casks, and this process is expected to begin at Indian Point in late 2007. Indian Point currently maintains over 1,500 tons of waste on

site, and additional radioactivity in the reactor cores. The amount of radioactivity at the plant is equivalent to several Chernobyls, and hundreds of Hiroshima bombs.

The federal government has designated Yucca Mountain in Nevada as a permanent site for high level nuclear waste. Yucca has encountered much opposition, and will not open until at least 2018 (according to the U.S. Energy Department). Some experts believe that Yucca Mountain or any permanent repository will never open, leaving existing nuclear plants to maintain the waste indefinitely.

II. Health Hazards Posed by Reactor Meltdowns

A. Description. Much of the health concern posed by nuclear reactors is on the effects of a major meltdown. The radioactivity in a reactor core and waste pools must be constantly cooled by water, or the fuel will overheat, causing a huge release of radioactivity. This release can be caused by mechanical failure (such as what happened at Chernobyl in 1986) or by a deliberate act of sabotage.

Hiroshima and Nagasaki showed how high levels of radioactivity can harm humans. Those closest to the bombs were vaporized, literally melting from the intense heat. But many other victims who survived the blast developed acute radiation poisoning, marked by nausea, vomiting, diarrhea, skin burns, weakness, dehydration, bleeding, hair loss, ulcerations, bloody stool, and skin sloughing, according to the Medical Encyclopedia of the National Library of Medicine. A large number of bomb survivors also developed cancers over the next several decades; thyroid cancer had the greatest excess. (Source: Thompson DE et al. Cancer Incidence in Atomic Bomb Survivors. Part II: Solid Tumors, 1958-1987. Radiation Effects Research Foundation, Hiroshima Japan, 1994).

B. Estimates of Casualties. If a meltdown that caused large scale releases of radioactivity from the reactor core or the waste pools occurred at Indian Point, there would be no vaporizing of humans. However, many would suffer from acute radiation poisoning (short term) and cancer (long term). Several estimates have been made to calculate just how many would be harmed. In 1982, the Sandia National Laboratories submitted estimates to Congress for each U.S. nuclear plant (Indian Point estimates are in Table 1).

Table 1
Estimated Deaths/Cases of Acute Radiation Poisoning and Cancer Deaths
Near Indian Point, Following a Core Meltdown

Type of Effect	Indian Point 2	Indian Point 3
Deaths, Acute Radiation Poisoning	46,000	50,000
Cases, Acute Radiation Poisoning	141,000	167,000
Cancer Deaths	13,000	14,000

Note: Acute radiation poisoning cases/deaths calculated within 17.5 miles from the plant, cancer deaths within 50 miles from the plant. Source: Sandia National Laboratories, Calculation of Reactor Accident Consequences (CRAC-2) for U.S. Nuclear Power Plants. Prepared for U.S. Congress, Subcommittee on Oversight and Investigations, Committee on Interior and Insular Affairs. November 1, 1982.

The Sandia figures are known as CRAC-2 (for Calculation of Reactor Accident Consequences). CRAC-2 estimated casualties for Indian Point are one of the highest of

any U.S. nuclear plant. Many believe the figures should be much larger, since the local population has grown since 1982 when the calculations were made, and people beyond a 17.5 mile radius from the plant will also suffer adverse health consequences.

More recently, the Union of Concerned Scientists prepared an estimate of casualties after a core meltdown from a terrorist attack. The 2004 report entitled "Chernobyl on the Hudson" estimated much higher casualties than did the 1982 Sandia effort. The Union's Dr. Edwin Lyman calculated that as many as 44,000 near term deaths from acute radiation syndrome within 50 miles and 518,000 long term deaths from cancer within 60 miles could occur, depending on weather conditions. (Source: Lyman ES, Chernobyl on the Hudson?: The Health and Economic Impacts of a Terrorist Attack on the Indian Point Nuclear Plant." Washington DC: Union of Concerned Scientists, 2004. www.ucsusa.org).

Indian Point is more vulnerable to a meltdown from mechanical failure than most reactors because of its age, and more vulnerable to a terrorist attack due to its proximity to New York City. Since the terrorist attack on the World Trade Center of September 11, 2001, much attention has been paid to the Indian Point as a potential terrorist target.

The reactors are also more vulnerable to a meltdown due to its parts corroding as the plant ages and as the reactors operate much more of the time in recent years; the operating factor from 2001-2004 was 94.6% and 95.6% for the two reactors (average 95%), an increase from the pre-1995 factors of 64.7% and 50.4% (average 58%). Source: U.S. Nuclear Regulatory Commission, in The New York Times, October 2, 1995.

The potential for a meltdown, while not highly likely, is a reality. A recent report by Greenpeace entitled "An American Chernobyl" identified 200 near-miss accidents at American reactors in the past two decades, four at Indian Point, all since 2000 (Table 2).

Table 2
Near Miss Accidents At Indian Point Since 1986

Date	Reactor	Description
February 15, 2000	Indian Point 2	Steam generator tube rupture
July 19, 2002	Indian Point 2	Degraded control room fire barrier
August 14, 2003	Indian Point 2	Loss of offsite power due to NE blackout
August 14, 2003	Indian Point 3	Loss of offsite power due to NE blackout

Source: An American Chernobyl: Nuclear "Near Misses" at U.S. Reactors Since 1986. Washington DC: Greenpeace, 2006. www.greenpeace.org.

III. Radioactivity from Indian Point

A. Environmental Releases from Indian Point. All nuclear reactors must routinely emit radioactivity into the environment in order to operate. There are several forms of these emissions. One is accidental releases due to leaking equipment, which can include the cladding and welds of fuel rods in the reactor core, cracks and breaks in fuel that damages cladding, corroding pipes, and cracked steam generator tubes. These scenarios result in radioactivity released into the air and water. Radioactivity is also deliberately released into the local environment about every 18 months when reactors refuel.

Each utility is required by federal law to measure and report annual radioactive environmental emissions from nuclear reactors. From 1970-1993, the federal government produced a comparative listing of annual emissions for each U.S. reactor (it has since been discontinued). One measure of environmental emissions is known as airborne "Iodine-131 and Effluents" or chemicals with a half life of at least eight days (and thus, are more likely to enter the body through breathing and the food chain). The list of the U.S. nuclear plants with the highest releases is given in Table 3:

Table 3
U.S. Nuclear Plants with Highest Emissions of Airborne Radioactivity, 1970-1993

Plant	Location	Reactors	Emissions*
1. Dresden	Morris IL	3	97.22
2. Oyster Creek	Forked River NJ	1	77.05
3. Millstone	Waterford CT	2	32.80
4. Quad Cities	Cordova IL	2	26.95
5. Indian Point	**Buchanan NY**	**3**	**17.50**
6. Nine Mile Point	Scriba NY	2	14.67
7. Brunswick	Southport NC	2	14.50
8. Three Mile Island	Londonderry PA	2	14.43

* Curies of Iodine-131 and effluents Source: Tichler J et al. Radioactive Materials Released from Nuclear Power Plants, annual reports. Upton NY: Brookhaven National Laboratory, NUREG/CR-2907.

The Indian Point total of 17.50 curies is the 5th highest of 72 U.S. plants, greater than the 14.43 curies from the Three Mile Island plant in Pennsylvania. Most of the Indian Point total occurred in 1985 and 1986, with a total of 14.03 curies from Indian Point 2. Several years later, totals were changed to 1.90 curies; the U.S. Nuclear Regulatory Commission attributed the change to a "clerical error." While original figures are used here, revised figures would still rank Indian Point as the 12th highest in the nation.

More recent data on emissions is posted on the Internet by the federal government. Data for all U.S. reactors are listed from 2001-2004, by quarter, and by type of emission. No information for Indian Point 2 is given, and data for Indian Point 3 is incomplete. But examination of types of airborne and liquid radioactive emissions with complete data for each quarter from 2001-2004 from Indian Point 3 is helpful in understanding the large variations over time (Tables 4 and 5).

For example, fission gases rose about six-fold from 4th quarter 2001 to the 1st quarter 2002 (about 15-fold for Xenon-133), about 100 times higher than 1st quarter 2001. Second quarter 2004 airborne fission gases were much higher than typical 2003 releases. More analysis is needed to understand reason(s) for these releases. But it is clear that there are very large swings in emissions levels over time.

Table 4
Airborne Radioactivity Released from Indian Point 3, in Millicuries by Quarter, 2001-04

Quarter	Xenon-133	Tot. Fission Gases	Tritium
1st Q 01	59	91	360
2nd Q 01	218	251	457
3rd Q 01	321	1040	1120
4th Q 01	378	1400	1430
1st Q 02	5580	8180	1310
2nd Q 02	1820	3790	1670
3rd Q 02	166	202	1540
4th Q 02	33	55	679
1st Q 03	141	181	495
2nd Q 03	190	229	828
3rd Q 03	371	525	951
4th Q 03	523	1590	830
1st Q 04	144	204	1420
2nd Q 04	1290	1450	1340
3rd Q 04	29	58	1140
4th Q 04	36	121	1570

One millicurie is 1/1000th of a curie. The physical half lives of Xenon-133 and Tritium are 5.24 days and 12.3 years, respectively. Source: U.S. Nuclear Regulatory Commission. www.reirs.com/effluent/EDB

Table 5
Liquid Radioactivity Released from Indian Point 3, in Millicuries by Quarter, 2001-04

Quarter	Fission/Activation Products	Tritium
1st Q 01	27.0	251,000
2nd Q 01	51.4	170,000
3rd Q 01	36.4	22,900
4th Q 01	12.0	482,000
1st Q 02	4.5	31,900
2nd Q 02	2.5	19,600
3rd Q 02	7.6	51,400
4th Q 02	14.0	692,000
1st Q 03	3.9	667,000
2nd Q 03	27.3	61,800
3rd Q 03	7.5	187,000
4th Q 03	6.3	38,500
1st Q 04	3.1	28,800
2nd Q 04	3.0	71,800
3rd Q 04	4.7	44,900
4th Q 04	4.8	530,000

One millicurie is 1/1000th of a curie. The physical half life of Tritium is 12.3 years. Source: U.S. Nuclear Regulatory Commission. www.reirs.com/effluent/EDB

B. Radioactivity Levels in Bodies near Indian Point. The question of how much man-made radioactivity enters human bodies was first considered in the 1950s, when the U.S. government sponsored studies that measured bone and teeth samples for Strontium-90, one of the 100-plus chemicals found in nuclear weapon explosions and nuclear reactor

operations. A landmark study of baby teeth in St. Louis found that the average Sr-90 level for children born in 1964 (just as atomic bomb testing was stopped) was about 50 times greater than for children born in 1950. Furthermore, Sr-90 studies found that average concentrations in bodies plunged by about half from 1964 to 1969, after large-scale weapons testing in the atmosphere was banned. Similar studies of Sr-90 in bone and teeth in Europe found similar patterns. (Sources: Rosenthal HR. Accumulation of environmental strontium-90 in teeth of children. In: Proceedings of the Ninth Annual Hanford Biology Symposium, Richland WA, May 5-8, 1969. Washington DC: U.S. Atomic Energy Commission, 1969. Health and Safety Laboratory, U.S.Atomic Energy Commission. Strontium-90 in Human Vertebrae. In: Radiation Data and Reports, monthly volumes, 1964-1969).

Government officials dropped their in-body radiation monitoring programs in 1970, 1971, and 1982. No studies measuring in-body levels near U.S. nuclear plants existed until 1996, when the independent research group Radiation and Public Health Project initiated an effort measuring Sr-90 in baby teeth. RPHP used a machine designed to measure low-dose radioactivity levels and selected the REMS radiochemistry lab of Canada to establish protocols and test teeth.

The lab calculated the ratio of Sr-90 to calcium, and RPHP converted it to a ratio at birth, using the Sr-90 half life of 28.7 years. Most Sr-90 in a baby tooth is taken up during the last six months of pregnancy and the first few months of life. A tooth from a person age 28.7 years with a current ratio of 4.30 would have an at-birth ratio of 8.60. Teeth were classified according to where the mother lived during pregnancy and the first year of life, not the current residence.

RPHP has tested nearly 5,000 baby teeth, and published five medical journal articles on results. Average Sr-90 in baby teeth was 30-50% higher in counties closest to six U.S. nuclear plants, and rose about 50% from the late 1980s to the late 1990s (reversing a prior decline), as reactors aged and were in operation more frequently. Results were statistically significant, suggesting strongly that reactor emissions were entering human bodies. (Source: Mangano JJ et al. An unexpected rise in Strontium-90 in US deciduous teeth in the 1990s. The Science of the Total Environment 2003;317:37-51).

Over 500 teeth were collected and tested from the New York metropolitan area partly supported by a $25,000 grant from the Westchester County legislature. The average local Sr-90 level was highest in the four New York counties closest to Indian Point – Westchester, Rockland, Orange, and Putnam (3.78 picocuries per gram of calcium), followed closely by Fairfield County CT (3.45). The average in Fairfield exceeded both New York City and Long Island (Table 6).

Table 6
Average Strontium-90 in Baby Teeth, New York Metropolitan Area

Region	Teeth	Average Sr-90
4 NY Cos. Near Indian Point	279	3.78
Fairfield County	32	3.45
New York City	161	3.10
Long Island	94	2.75

Average = picocuries of Sr-90 per gram of calcium at birth. Only births after 1979 included.
Source: Radiation and Public Health Project

While the tooth study provided some unique and important data, it is difficult to demonstrate exactly how the Sr-90 entered children's bodies. (Some is from the mother's bone stores, some through the mother's diet during pregnancy, and some through the baby's diet during infancy). Sr-90 enters bodies through milk, water, vegetation, and breathing. These limits do not, however, negate the importance of consistent and significant findings of high and rising levels of radioactivity closest to Indian Point.

IV. Potential Health Risks from Indian Point in Fairfield County
A. Rises in Connecticut Childhood Cancer. Evidence suggests that exposure to fission products may have increased the risk of cancer in Connecticut – especially in children, who are most susceptible to radiation. Historical data shows that cancer in the youngest children – which most likely reflects harm during pregnancy – rose during above ground atomic bomb tests, and when nuclear reactors in and near the state operated.

Atmospheric nuclear weapons tests began in 1946 and ended in 1963. Connecticut cancer incidence age 0-4 from the late 1940s to the early 1960s rose from 14.86 to 19.37 cases per 100,000, up 30.3%. From 1967-1975, an additional five nuclear reactors in or near Connecticut began operating, two at Millstone, one at Connecticut Yankee, and two at Indian Point. Cancer incidence age 0-4 in the state rose from 15.28 to 23.13 cases per 100,000 from the late 1960s to the late 1990s, up 51.4% (Table 7).

Table 7
Conn. Cancer Incidence 0-4 During Bomb Tests/Reactor Operations, by 4-Year Periods

	Period of Bomb Testing			Period of Reactor Operations			
Period	Cases	Pop.	Rate	Period	Cases	Pop.	Rate
1945-48	105	706,630	14.86	1967-70	159	1,040,253	15.28
1949-52	139	803,118	17.31	1971-74	159	934,719	17.01
1953-56	155	921,131	16.83	1975-78	154	762,114	20.21
1957-60	175	1,082,820	16.16	1979-82	120	755,805	15.88
1961-64	217	1,120,124	19.37	1983-86	178	819,734	21.71
				1987-90	192	911,497	21.06
				1991-94	197	942,986	20.89
				1995-98	202	873,425	23.13

Source: Connecticut Tumor Registry

B. Fairfield County as a Low-Risk Area. Fairfield County CT is located to the east-southeast of Indian Point, 16 miles away at its closest point in Greenwich and 45 miles away at its most distant in Stratford, making it the closest county in the state to Indian Point. The current county population is just over 900,000. It consists of 23 cities and towns, the largest of which are Bridgeport, Stamford, and Norwalk.

Fairfield County is not at apparent risk for health problems. Its population is better educated, has a higher income level, and has a lower unemployment rate than the nation, suggesting healthier living conditions and better health practices (Table 8). In addition to adequate financial access to medical care, Fairfield's location close to New York City gives its residents access to world class medical care.

Table 8
Demographic Comparison, Fairfield County vs. U.S.

Characteristic	Fairfield	United States
2006 Estimated population	900,440	299,398,484
2005 % Black	10.7	12.8
2005 % Hispanic	14.0	14.4
2005 % Asian	4.1	4.3
2000 % Foreign Born	16.9	14.4
2000 % HS grad > 25	84.4	80.4
2000 % Coll grad > 25	39.9	24.4
2000 % w Disability >5	16.0	19.0
2004 Median Household Inc	$60,790	$44,334
2004 % Below poverty	8.5	12.7
2006 % Unemployment	3.8	4.6

Sources: U.S. Department of Agriculture, www.ers.usda.gov/data/unemployment (for unemployment). U.S. Census Bureau, www.census.gov, state and county quick facts (all other data).

C. Low Weight Births. As mentioned, the fetus and infant are most sensitive to the toxic effects of radiation exposure. The infant mortality rate in Fairfield County is below the national rate, as advances in medical treatment (most available to the affluent) save more lives than ever before. However, the healthy development of the fetus is not as likely to reflect medical treatment. Table 8 shows that in recent years, the rate of Fairfield County babies born at very low weight (under 3.3 pounds) exceeds the U.S. rate by 3%, 12%, 3%, and 32% for whites, blacks, Asians, and Hispanics.

Table 8
Underweight Births by Race, Fairfield County vs. U.S., 1996-2002

	Live Births		Rate/100 Births		
Race	<3.3 lbs.	Total	County	U.S.	% Co. vs. U.S.
Whites	839	71538	1.17	1.14	**+ 2.6%**
Blacks	375	10862	3.45	3.07	**+12.4%**
Asian	43	3953	1.09	1.06	**+ 2.8%**
Am. Indian	4	138	2.90	1.12	-----
TOTAL	1261	86491	1.46	1.43	**+ 2.1%**
(Hispanic	215	14379	1.51	1.14	**+32.4%**)

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov, births. Excludes births with no stated weight. 3.3 pounds equals 1500 grams. Hispanics are can be in any racial group.

C. Cancer Incidence. The Connecticut Tumor Registry began in 1935, making it the oldest in the United States. Table 9 compares recent (1998-2002) incidence of all cancers combined in Fairfield County with the U.S. The county rate is 8% and 7% above the U.S. for males and females, respectively. A total of 33,975 cancer cases were diagnosed among county residents during the five-year period.

Table 9
Cancer Incidence, Fairfield County vs. U.S., 1998-2002

	Fairfield County			
Area	Cases	Cases/100000	U.S. Cases/100000	% Co. vs. U.S.
Males	12222	613.4	567.0	**+8.2%**
Females	11753	450.2	421.9	**+6.7%**

Source: Connecticut Tumor Registry, Department of Public Health, www.state.ct.us (Connecticut data). Surveillance Epidemiology and End Results system, www.seer.cancer.gov (U.S. data, nine states and cities representing 10% of U.S. population, including Connecticut).

One of the most radiation-sensitive types of cancer is breast cancer in women. Breast cancer incidence has soared during the past two decades in the U.S., including in Connecticut. The 1998-2002 breast cancer incidence rate in Fairfield County is 6% higher than the U.S. rate (145.8 vs. 137.1 per 100,000). Nearly 800 Fairfield County women are diagnosed with the disease each year.

Within Fairfield County, there are variations in cancer incidence. Rates for the 12 cities and towns closest to Indian Point (and southeast, or directly downwind of prevailing winds during the colder months) were compared with those for the 11 more distant cities and towns. The most recent data available are from 1995-1999 (Table 10).

For all cancers, incidence for the 3.6% below the state rate for the 12 closest towns, but 7.7% below for the other towns. For breast cancer, the rate for the 12 closest towns equaled the state rate, but was 13.4% lower for the other towns. Differences are significant, and excess cancer cases in the five years equal 554 (all) and 327 (breast).

Table 10
Incidence, All Cancers and Female Breast Cancer, By Area of Fairfield County, 1995-99

Area of County	Cases, 1995-99 Actual	Expected*	% Above/Below CT
All Cancers			
Twelve Towns Nearest Indian Point	12940	13420	**- 3.6%**
Other Fairfield County	8141	8817	**- 7.7%**
Female Breast Cancer			
Twelve Towns Nearest Indian Point	2097	2094	**+ 0.0%**
Other Fairfield County	1224	1413	**- 13.4%**

* Expected cases if local rate equaled state rate. For all cancers, difference is significant ($p<.001$); excess cases = 554. For breast cancer, difference is significant ($p<.001$); excess cases = 327. Twelve towns are Darien, Easton, Fairfield, Greenwich, New Canaan, Norwalk, Ridgefield, Stamford, Trumbull, Weston, Westport, and Wilton. Source: Incidence of Selected Cancers in Connecticut by Town 1995-99, www.dph.state.ct.us/OPPE/hptumor.htm.

D. Cancer Mortality. The type of cancer most extensively studied for risks of radiation exposure is childhood cancer. In the past two decades, the rate of Fairfield County children under ten who died of cancer was 10.7% above the U.S. rate. This compares to a local rate 25.8% below the U.S. for all other causes for children under ten (Table 11).

Table 11
Mortality Rates, Cancer/Other Causes, Age 0-9, Fairfield County vs. U.S., 1987-2004

Area	Deaths	Ann Pop	Rate	% Co. vs. U.S.
Cancer				
Fairfield County	79	120903	3.63	**+10.7%**
United States	22760	38563621	3.28	
All Other Causes				
Fairfield County	1691	120903	77.70	**- 25.8%**
United States	726815	38563621	104.71	

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov, underlying cause of death. Uses ICD-9 cancer codes 140.0-239.9 (before 1999) and ICD-10 cancer codes C00-D48.9 (1999 and after). Difference significant at $p<.05$.

The gap between deaths from cancer and other causes in Fairfield County also exists for persons of all ages. In the past two decades, the county death rate from cancer was 5.6% below the U.S., but 15.7% below for all other causes. From 1987-2004, 31,740 Fairfield County residents died of cancer (Table 12).

B. Precedent – Nuclear Reactor Closing. Most radioactivity in the core of a nuclear reactor consists of chemicals that decay relatively quickly. A recent report calculated that a core meltdown just 20 days after shutdown of a fully operational reactor would mean 50% fewer cancer deaths and 81% fewer acute radiation deaths within 50 miles. Source: Lyman ES. The Impact of Nuclear Plant Shutdown on Severe Accident Consequences. Washington DC: Nuclear Control Institute, February 12, 2002.

Like atomic bomb test cessation, there may be a precedent for cancer reductions after nuclear reactors close and radioactive releases end. A 2002 journal article by the Radiation and Public Health Project examines downwind areas near reactors that closed from 1987-1998 that were at least 70 miles from any other nuclear plant. Cancer incidence age 0-4 fell near each plant (total of -24.8%), even though there was a slight increase in U.S. childhood cancer during this period (Table 14).

Table 14
Change in Cancer Incidence, Age 0-4, Before and After Reactor Closing
Counties Downwind and <40 Miles of Closed Reactors

Reactor	Year Closed	Counties Downwind and <40 Miles
LaCrosse	1987	LaCrosse, Vernon WI
Rancho Seco	1989	Amador, El Dorado, Placer, Sacramento CA
Fort St. Vrain	1989	Larimer, Weld CO
Big Rock Point	1997	Antrim, Charlevoix, Cheboygan, Emmet, Otsego MI
Maine Yankee	1997	Kennebec, Knox, Lincoln ME
Zion	1998	Lake IL; Kenosha, Racine WI

	Before	After	Cases/100,000 (No.)		
Reactor	Close	Close	Before	After	% Change
LaCrosse	'86-87	'88-94	40.0 (7)	24.6 (15)	**-38.5%**
Rancho Seco	'88-89	'90-96	24.0 (50)	17.6 (153)	**-26.9%**
Fort St. Vrain	'88-89	'90-96	20.3 (10)	18.0 (32)	**-11.7%**
Big Rock Pt.	'96-97	'98-00	45.0 (7)	21.1 (5)	**-53.1%**
Me. Yankee	'96-97	'98-01	38.1 (8)	27.2 (11)	**-28.5%**
Zion	'97-98	'99-00	21.2 (32)	19.7 (30)	**- 7.0%**
TOTAL			24.7 (114)	18.5 (246)	**-24.8%**
U.S. ANNUAL AVERAGE CHANGE, 1986-1998					**+ 0.3%**

Sources: State cancer registries, in Mangano JJ et al. Infant Death and Childhood Cancer Reductions after Nuclear Plant Closings in the United States. Archives of Environmental Health 2002;57(10):23-32.

C. Potential Cancer Reductions After Indian Point Closing. There are potential implications of these historical trends for Fairfield County if Indian Point were to cease operating. County rates of low weight births, cancer incidence, and cancer mortality often exceed the national rate, even though there are no obvious local risk factors. With about 4,000 and 2,000 Fairfield county residents being diagnosed with and dying of cancer each year, reduced exposures to radioactive chemicals could reduce those with cancer by hundreds each year. Such a change would be of great benefit to society, as it

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
Lawrence G. McDade, Chairman
Dr. Richard E. Wardwell
Dr. Kaye D. Lathrop

In the matter of	**DOCKET NOS.**
ENTERGY NUCLEAR OPERATIONS, INC.	**50-247-LR**
(Indian Point Nuclear Generating Units	**50-286-LR**
2 and 3)	**December 10, 2007**

DECLARATION OF HELEN M. CALDICOTT, M.D.

Helen M. Caldicott, M.D., hereby declares under penalty of perjury that the following is true and correct:

1. I am a physician certified as a member of the Royal Australasian College of Physicians in Pediatrics and a diplomate of the American Board of Pediatrics.

2. I have served as Assistant in Medicine, Children's Hospital Medical Center, Harvard (1977-1980) and Instructor in Pediatrics at Harvard Medical School (1977-1980).

3. I am founder and served as President (1978-1983) and President Emeritus (1983-Present) of Physicians for Social Responsibility.

4. I served as co-founder of Standing for Truth About Radiation (STAR) Foundation in 1997 and served as President 1999-2000.

5. I founded served as President of Nuclear Policy Research Institute (2001-2007).

6. I am an author, most recently of *Nuclear Power Is Not the Answer* (2006), and I have lectured around the world on medical hazards of nuclear power generation.

7. My *curriculum vitae* is attached hereto.

8. I submit this Declaration addressed to the medical hazards of nuclear power

generation, all of which apply to the Indian Point Nuclear Power Station, in support of the Petition to Intervene and Request for Hearing of Connecticut Residents Opposed to Relicensing of Indian Point (CRORIP) and its Designated Representative.

9. Nuclear power plants cannot operate without releasing large amounts of radioactive gases and elements into the air and cooling water every day - labeled "routine releases" by the nuclear industry.

10. These emissions include the fat-soluble noble gases krypton, xenon and argon. If inhaled by people living near a nuclear reactor, they are absorbed through the lungs and migrate to the fatty tissues of the body, including the abdominal fat pad and upper thighs, near the testicles and ovaries.

11. These radioactive elements, which emit high-energy gamma radiation, can then irradiate the eggs and sperm, mutating the genes, which will increase the incidence of genetic diseases like diabetes and cystic fibrosis over time.

12. Several of the more dangerous isotopes to which noble gases decay (all of which have different metabolic pathways in the body) include the following:

Xenon 137, with a half-life of 3.9 minutes, converts almost immediately to cesium 137 with a half-life of 30 years;

Krypton 90, half-life of 33 seconds, decays to rubidium 90, half-life of 2.9 minutes, then to the medically toxic strontium 90, half-life of 28 years;

Xenon 135 decays to cesium 135 with a half-life of 3 million years;

13. Large amounts of xenon 133 are released at operating reactors, remaining radioactive for 106 days.

14. Krypton 85,with a half-life of 10.4 years, is a powerful gamma emitter.

15. Xenon 141, 143 and 144 decay to cerium 141, 143 and 144, beta emitters with moderately long half-lives, bio-concentrate in the food chain and they irradiate the lung, liver, skeleton and gastrointestinal tract where they act as potent carcinogens.

16. Tritium, another biologically significant gas, is continuously emitted from nuclear reactors. It is a radioactive isotope of hydrogen composed of two neutrons and one proton with an atomic weight of 3. The chemical symbol for tritium is H3. When one or both of the hydrogen atoms in water is displaced by tritium the water molecule is then radioactive and is called tritiated water. Tritium, a potent carcinogen, is incorporated directly into the DNA molecule of the gene. Its half-life is 12.3 years, giving it a biologically active life of 246 years. It passes readily through the skin, lungs and digestive system and is distributed throughout the body. Because tritium is a soft energy beta emitter - meaning it does not penetrate very far - all the radiation it gives off is readily absorbed by the surrounding cells and hence it is biologically very mutagenic.

17. Radioactive gases that leak from fuel rods are routinely released or "vented" into the atmosphere from nuclear power plants. About 100 cubic feet of radioactive gases are released hourly from the condensers at the reactors. Planned ventings increase in frequency when the reactor shuts down due to mechanical malfunctions. Accidental ventings are not infrequent.

18. Planned "purges," when radioactive gases are actively flushed into the atmosphere by a fan, are permitted by the Nuclear Regulatory Commission so that utility operators can decrease the intensely radioactive environment into which maintenance workers must enter. Older reactors are allowed 22 purges per year during routine operation and two per year during refueling.

19. Dangerous elements in primary coolant filters almost certainly escape in small quantities via gaseous and liquid effluents into the environment, including: technetium 99 with a half-life of 211,100 years; iodine 129 with a 15,700,000-year half-life; carbon 14 with a 5,700-year half-life; nickel with a 100.1-year half-life; and plutonium 241 with a14.29-year half-life. Once in the environment, these carcinogens will bio-concentrate in the food chain.

20. Radioactive iodine-131, with a half-life of 8 days, enters the body through inhalation and is circulated by the bloodstream and readily absorbed by the thyroid gland at the base of the neck. Children are at special risk from this isotope because their tiny developing thyroids absorb iodine from the blood like a sponge.

21. Strontium 90, a beta and gamma emitter with a half-life of 28 years, remains dangerous for 600 years. It is routinely released from reactors. As a calcium analogue, strontium-90 mimics calcium in the body. It is readily absorbed in teeth and bones, there to induce bone cancer or leukemia.

22. Cesium 137, with a half-life of 30 years, concentrates in muscle tissue where it irradiates muscle cells and other nearby organs. It is a dangerous beta and high-energy gamma emitter and is very carcinogenic. Exposure to cesium-137 may account for an epidemic of a rare form of cancer in children called rhabdomyosarcoma near the Brookhaven National Laboratory on Long Island in the 1980s.

23. Most of the data on radiation releases are not real measurements but are only estimates made by computer-generated mathematical models based on data generated from operational reactors, field and laboratory tests and plant-specific design calculations. Hence, the nuclear industry is consistently guessing about its radioactive

releases and has no real idea what specific isotopes are escaping from its plants. The last document available for public scrutiny that quantified actual releases, not just guesstimates, of radioactive materials from nuclear power plants was published by the NRC in 1978, at a time when reactors were relatively young and plagued with fewer corrosion and maintenance problems than exist at present.

24. As nuclear reactors age, they are more likely to suffer equipment failures associated with aging of their mechanical parts. The NRC aging-management programs are failing to head off the equipment failures these programs are designed to prevent.

25. One example involves Indian Point 2. On February 15, 2000, a steam generator at Unit 2 released some 19,197 gallons of intensely radioactive water from the primary coolant into the atmosphere. The then-owner of the plant had detected indications of degradation during steam generator inspections in 1997 but had failed to correct the problem.

26. There is a variation in sensitivity to radiation: children, old people and immunocompromised individuals are many times more sensitive to the malignant effects of radiation than other people. The incubation time for cancer to result from exposure to low-level ionizing radiation may be as long as 5-50 years after exposure.

27. People living near nuclear power plants will be exposed to radiation in the air, in their water and in their food as tritium and other radioactive elements concentrate in vegetables and fruit.

28. It is therefore medically unsafe to live near a nuclear power plant.

30. Pursuant to 28 U.S.C. §1746, I declare under penalty of perjury that the foregoing is true and correct.

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_Signed: Helen Caldicott Date:12/3/2007

Helen M. Caldicott, M.D.

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AUSTRALIA

Helen Caldicott, MD
PHYSICIAN - AUTHOR - SPEAKER

Curriculum Vitae

Education | **Training** | **Fellowship** | **Hospital Appointments** | **Teaching Appointments** | **Professional Certifications** | **Medical and Nuclear Education/Public Advocacy** | **Speeches/Presentations** | **Commencement Addresses** | **Awards/Nominations** | **Honorary Degrees** | **Publications** | **Miscellaneous** | back to Dr. Caldicott's **Biography**

Education

M.B., B.S. (Bachelor of Medicine, Bachelor of Surgery)
Adelaide Medical School, South Australia, 1961

Training

Residency: Adelaide Children's Hospital, 1973-1974
Internships: Adelaide Childrens's Hospital, 1972;
Royal Adelaide Hospital, 1961

Fellowship

Research Fellow, Nutrition Clinic, Children's Hospital
Medical Center, Boston, Massachusetts 1967-1968

Hospital Appointments

Founder and Director, Cystic Fibrosis Clinic, Adelaide Children's Hospital, 1975-1976
Assistant in Medicine, Children's Hospital Medical Center, Harvard, 1977-1980

Teaching Appointments

Instructor in Pediatrics, Harvard Medical School, 1977-1978
Instructor, New School for Social Research, New York, 1995-1996
Laurie Chair in Womens Studies, Douglass College, Rutgers University, February-May, 2001

Professional Certifications

Member, Royal Australasian College of Physicians in Pediatrics
Member, American Thoracic Society
Diplomate, American Board of Pediatrics

Medical and Nuclear Education/ Public Advocacy

United States
Physicians for Social Responsibility (PSR)
- Founder and President, 1978-1983
- President Emeritus, 1983-Present

Women's Action for Nuclear Disarmament (WAND)
- Founder, 1980

Nuclear Freeze Voter Initiative Campaign, 1980
- Co-Leader

STAR (Standing For Truth About Radiation) Foundation
- Co-Founder, 1997; President, 1999-2000

Nuclear Policy Research Institute

- President, 2001- Current

Australia and New Zealand
Initiated movement against French atmospheric tests, 1971-72

Led education campaign among Australian labor unions about medical and military dangers or uranium mining, 1975-1976

Led public New Zealand education campaign, with Dr. William Caldicott, resulting in the official New Zealand nuclear-free policy, 1982

Founded Green Labor, a new section within Australian Labor Party, 1988

Ran as Independent Candidate for Australian Federal Parliament, 1990

Founding Patron, Parents Protecting Our Children Against Radiation, Lucas Heights, NSW, 1998

Founder, Our Common Future Party (OCF), Australia 2000

Europe
Helped organize English, Scottish, West German, Dutch, Belgian, Danish, Swedish, and Norwegian medical campaigns for prevention of nuclear war, 1980

Member of American Friends Service Committee delegation which met with Soviet physicians and scientists on the medical consequences of nuclear power and nuclear war; also met with high-ranking Soviet officials to discuss terms of Salt II Treaty, 1979

< top >

Speeches/ Presentations

Special Meetings
Joint presentation with Dr. Carl Sagan before sixty members of the US Senate, 1985

Addressed UN Staff Committee for Nuclear Disarmament, 1985

Testified before Australian Federal Senate Special Committee, 1998

Personal meetings with Prime Minister Pierre Trudeau; Former US Ambassador to the Soviet Union, George Kennan; Soviet Ambassador to the US, Anatoly Dobrynin; and President Ronald Reagan, 1982-1983

Conferences/Presentations (Selected List)
National Women's Political Caucus, Address, 1979
American Society of Civil Engineers, Keynote Address, 1980
American Medical Students Associations, Keynote Address, 1980
American Association for the Advance of Science, 19980
Gulf Coast Council on Foreign Relations, 1981
United Electrical, Radio and Machine Workers of America, Keynote Address 1982
June 12 Disarmament Rally in New York City, 1982
Women's National Democratic Club, 1982
American Academy of Pediatrics, Keynote Address 1982
American Academy of Family Physicians, Keynote Address, 1982
National Freeze Campaign, Closing Address, Annual Conference, 1983

National Press Club, Luncheon Address, 1983
National Association of Newspaper Editors, Debate, 1983
World Council of Churches 60th Assembly, Opening Plenary Address, 1983
American Association of Marriage and Family Therapists Annual Convention 1984
International Association of Social Workers, Speaker 1984
International Association of Machinists and Aerospace Workers, Keynote Address, 1984
University of Toronto, Bronowski Lecture, 1984
International Women's Conferences, Los Angeles, Moscow, Dublin, Keynote Speaker, 1984
National Women's Conference on Preventing Nuclear War, Washington, D.C. 1984
Stanford University, McCormick Lecture,1984
Featured Speaker at major events throughout the United States on behalf of WAND, 1985 - 2002
EcoPolitics Conference, Keynote Speaker, Sydney, 1991
Rio Earth Summit Conference, Address, 1992
World Affairs Conference, Boulder, Colorado, Opening Speaker, 1994
National Coalition of Girls Schools Annual Meeting, Guest Speaker, Farmington, Connecticut, 1997
New Zealand College of Family Practitioners, Keynote Address, 1997
Rutgers University, Shaping a Life Series, Guest Speaker, 1997 and 1998
University of Oregon, Guest Speaker, 1997
Oregon Health Sciences University, Guest Speaker, 1997
Los Angeles Public Library, The Big Questions Series, Guest Speaker, 1997
Presbyterian Church, Investigation into Nuclear Power Conference, Santa Fe, 1997
Vermont Law School, Guest Speaker, 1998
Cleveland (Ohio) City Club, Guest Speaker, 1998
Symposium on Effects of Low-level Radiation, New York Academy of Medicine, Principal Convenor and Speaker, 1998
Brainstorm 2002: the FORTUNE editors' invitational, Aspen, Colorado, Panel Expert, 2002
The Fontainebleau Symposium - On Innovation and Society INSEAD, Fontainebleau – France, Guest Speaker, 2002
Smith College, Northampton, Massachusetts, Guest Speaker, 2002
Wallace Stegner Center Symposium, The Nuclear West: Legacy and Future, Salt Lake City, Utah, Guest Speaker, 2003
Nuclear Policy Research Institute, Symposium on the Health Effects of Depleted Uranium Munitions, New York Academy of Medicine, Principal Convenor and Speaker, 2003
Los Alamos National Laboratory, Plutonium Futures - The Science 2003, Albuquerque, New Mexico, Guest Speaker, 2003
Keynote speaker, Strategies for a World Without Nuclear Option, Linz, Austria, November 2003
Nuclear Policy Research Institute, Symposium: Three Minutes to Midnight, Omni-Shoreham Hotel, Washington, DC, Principal Convenor and Speaker, January 2004
IPPNW International Congress, keynote speech, Berlin, Germany, May 2004
The Cosmos Club, luncheon speaker, Washington, DC, September 2004
Nuclear Policy Research Institute, Symposium: Nuclear Power and

Children's Health, Chicago, IL, Principal Convenor and Speaker, October 2004
Nuclear Policy Research Institute, Symposium: Full Spectrum Dominance, Airlie House, Warrenton, VA, Principal Convenor and Speaker, May 2005
Next Generation, keynote speaker, Marin County, CA, October 2005
Non-proliferation and disarmament: The Way Forward, keynote speaker, Boston, MA, October 2005
Nuclear Policy Research Institute, Symposium: Nuclear Power and Global Warming, Airlie House, Warrenton, VA, Principal Convenor and Speaker, November 2005
Williams College, public lecture, Williamstown, MA, May 2006
The New School, public lecture, New York, NY, May 2006

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Commencement Addresses

Numerous commencement addresses, including Tufts University School of Medicine, Harvard University School of Public Health, Williams College, Smith College, Washington University School of Medicine, University of Notre Dame, Salem State College, Emmanuel College, Medical College of Pennsylvania, State University of New York at Binghamton, University of Massachusetts Medical School,and University of California School of Medicine, Irvine, 1997

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Awards/ Nominations

Select List
United Automobile Workers International Women's Day Committee, Woman of the Year, 1973
Ethical Society of Boston, Humanist of the Year, 1980
Environmental Defense Center, Margaret Mead Award, 1980
Thomas Merton Society, Thomas Merton Prize for Peace, 1980
Promoting Enduring Peace, Gandhi Peace Prize, 1981
SANE Education Fund, SANE Peace Award, 1981
American Association of Humanist Psychology, Humanist of the Year, 1982
Massachusetts Audubon Society, Audubon "A" Award, 1982
Boston College, Woman of the Year Award, 1984
Massachusetts Bay Association of Writing Programs, Outstanding Writer, 1984
Brandeis University, Abraham L. Sacher Award, 1984
American Association of University Women, Peace Award, 1984
Massachusetts Psychology Association, Humanitarian Award, 1984
American Medical Women's Association, Elizabeth Blackwell Award, 1984
United Nations Association for Australia, Peace Medal Award, 1985
Hofstra University, President's Award, 1985
Physicians for Social Responsibility (International Physicians for the Prevention of Nuclear War), Nobel Peace Prize, 1985
John Roger Foundation, Integrity Award, 1985
American Ethical Union, Elliott Black Award, 1986
Second Biennial Fate of the Earth Conference, Ansel Adams Award, 1984
Physicians for Social Responsibility, Norman Cousins Award for Peacemaking, 1992
Architects, Designers and Planners for Social Responsibility, Louis Mumford Award, 1993
Nuclear Age Peace Foundation, Distinguished Peace Leadership

Award, 1994
Lannan Foundation, The Prize for Cultural Freedom, 2003
Peace Organisation of Australia, Australian Peace Prize, 2006

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Honorary Degrees

Selected List
Doctor of Humane Letters, Emmanuel College, Boston, 1980
Doctor of Humane Letters, Salem State College, Massachusetts, 1980
Doctor of Science, Williams College, 1980
Doctor of Letters, Westfield State College, 1981
Doctor of Humane Letters, Columbia College, Chicago, 1982
Doctor of Humane Letters, University of Massachusetts, 1983
Doctor of Laws, University of Notre Dame, 1983
Doctor of Humane Letters, Medical College of Pennsylvania, 1983
Doctor of Humane Letters, State University of New York at Binghamton, 1984
Doctor of Humane Letters, Antioch University, 1984
Doctor of Humane Letters, Russell Sage College, Troy, N.Y., 1986
Doctor of Laws, Northeastern University Law School, 1986
Doctor of Medicine, University of Linkoping, Linkoping, Sweden, 1986
Doctor of Science, Rutgers University, 1990
Doctor of Laws, Smith College, 1990
Doctor of Laws, University of Guelph, 1991
Doctor of Humane Letters, Marywood College, Scranton, Pennsylvania, 1993
Doctor of Education, University of Newcastle, Australia, 2000
Doctor of Humane Letters, University of Victoria, Vancouver, 2000

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Publications
see also **Books**

Missile Envy, Bantam Books, New York, 1985
If You Love This Planet, W.W. Norton, New York, 1992
Nuclear Madness: What You Can Do (Revised Edition), W.W. Norton, New York, 1994
A Desperate Passion: An Autobiography, W.W. Norton, New York, 1996 (published in Australia as A Passionate Life, Random House, Sydney, 1996)
The New Nuclear Danger, George W. Bush's Military Industrial Complex, The New Press, New York (US), Scribe Publications, Melbourne (Australia), 2002
Nuclear Power Is Not the Answer, The New Press, New York (US, Canada, UK), Melbourne University Press (Australia and New Zealand), 2006
War In Heaven, with Craig Eisendrath, PhD, The New Press, New York (US, Canada, UK), forthcoming

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Miscellaneous

Host, one-hour weekly radio program "Fair Dinkum" on WBAI-FM in New York City, 1995-1998
Founded a new political party in Australia called Our Common Future Party - 1999
Initiated a symposium in the US Congress in March 1999 on Nuclear Y2K
Named one of the most important women of the 20th Century by the Ladies Home Journal in the US

Films see also **Film**

Featured in Eight Minutes to Midnight by Mary Benjamin, Academy Award Nominee for Best Documentary, 1981
If You Love This Planet by Terri Nash and the National Film Board of Canada, Winner of the Academy Award for Best Documentary, 1982
In Our Hands by Action for Nuclear Disarmament 1982
The Crossroads of Time by Dick Bell, 1984
The Last Epidemic by Ian Thierman,
Helen's War: portrait of a dissident by Anna Broinowski, 2004

Media Coverage
Numerous television and radio appearances in the US, including The Today Show, Good Morning America, Fresh Air, ABC Nightline, The Montel Williams Show, the Faith Williams Show, Studs Terkel, Sixty Minutes, Crossfire, Larry King Live, Donahue, Oprah, Wolf Blitzer Reports, CNN, C-SPAN Book-TV and *Reagan: The American Experience* (PBS). In Australia, The Midday Show, Life Matters, Good Morning, Australia, and Margaret Throsby.

In print, featured in major newspapers and magazines including *The New York Times, The Washington Post, The Christian Science Monitor, the Los Angeles Times, The Bulletin of the Atomic Scientists, The Boston Globe, Life Magazine, The Sydney Morning Herald, The Australian, The Age, Women's Weekly, Condé Nast, Ladies Home Journal* and *Ita*.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
Lawrence G. McDade, Chairman
Dr. Richard E. Wardwell
Dr. Kaye D. Lathrop

In the matter of DOCKET NOS.
ENTERGY NUCLEAR OPERATIONS, INC. 50-247-LR
(Indian Point Nuclear Generating Units 50-286-LR
2 and 3) December 10, 2007

DECLARATION OF LALLY CODRIANSKY

Lally Codriansky hereby declares under penalty of perjury that the following is true and correct:

1. My name is Lally Codriansky.

2. I reside at 1 Decatur Street in Greenwich, Connecticut.

3. My residence is located approximately miles downwind from the Indian Point Nuclear Power Station in Buchanan, New York.

4. I am a member of Connecticut Residents Opposed to Relicensing of Indian Point (CRORIPâ€¦).

5. Indian Point Units 2 and 3 (â€œIndian Pointâ€L) are owned by separate limited liability corporations and are operated by Entergy Nuclear Operations, Inc.

6. Entergy has recently applied to the U.S. Nuclear Regulatory Commission for 20-year extensions of the original 40-year licenses for Units 2 and 3.

7. I am gravely concerned about the prospect of continued operations of Indian Point during a 20-year extension period.

8. I believe that Indian Point poses an unacceptable risk to my health and safety and my ability to carry on my business activities.

9. I believe that in the event of an accident or attack on Indian Point, I could become ill or die from radiological contamination.

10. If such an event required evacuation, I fear that I would not be able to evacuate safely because of the well-known traffic congestion on the major interstate highway near my home, I-95, which in ordinary rush-hour conditions becomes seriously gridlocked.

11. I believe that on a daily basis Indian Point routinely releases radioactive effluent emissions into the air which are carried downwind and that as a consequence I am routinely subject to exposure to potent carcinogens which I cannot see, hear, feel or smell and therefore am helpless to protect myself against.

12. I am gravely concerned that such releases will increase during the projected license renewal period because of degraded plant conditions leading to increased cracks and leaks.

13. I am gravely concerned about the cumulative effect of such radiation exposures and their long-term impact on my health and the health of my family, my friends, my community.

14. I am gravely concerned about the accumulation of deadly high-level radioactive waste and the continued production of such waste at Indian Point when there is to date no approved plan for treatment and/or disposal of such waste, which will remain deadly for thousands of years.

15. I am gravely concerned about the health of children particularly, their young bodies will suffer the effects of deadly high-level radioactive waste and will have to deal with serious health issues as will be the case with adults as well.

16. I hereby authorize CRORIP to represent my interests by intervening in the license renewal proceeding for Indian Point Units 2 and 3, Docket Nos. 50-247, 50-286.

Lally Codriansky

Lally Codriansky

Dated: December 10, 2007

Sworn to and subscribed before me this 10 day of December, 2007

Notary Public

Date Commission Expires:

My Commission Expires
Feb. 28, 2012

My Commission Expires
Feb. 28, 2012

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
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In the matter of	**DOCKET NOS.**
ENTERGY NUCLEAR OPERATIONS, INC.	**50-247-LR**
(Indian Point Nuclear Generating Units	**50-286-LR**
2 and 3)	**December 10, 2007**

DECLARATION OF NANCY BURTON

Nancy Burton hereby declares under penalty of perjury that the following is true and correct:

1. My name is Nancy Burton.

2. I reside at 147 Cross Highway, Redding Ridge CT 06876.

3. My residence is located approximately 25 miles or less from the Indian Point Nuclear Power Station in Buchanan, New York.

4. I am a member of Connecticut Residents Opposed to Relicensing of Indian Point (CRORIP").

5. I have been authorized to act as designated representative of CRORIP by its members and I have been authorized to include its members in this proceeding as follows:

A. People's Action for Clean Energy (*per* Judi Friedman, director)

B. Connecticut Sierra Club (*per* John Calendrelli, field director)

C. Don't Waste Connecticut (*per* Mitzi Bowman, director)

D. Connecticut Green Party (*per* David Bedell, secretary of Fairfield County chapter)

E. Connecticut Toxic Action Center (*per* Sylvia Broude, community organizer)

F. Connecticut Citizens Awareness Network (per Sal Mangiagli, co-director)

G. Connecticut Youth Activist Network (per Colin Bennett, director)

H. David Bedell, Remy Chevalier, Mitzi Bowman, Gail Merrill, Lucy Lee Grimes Evans, Paula Panzarella, Frank Panzarella (*per* individual conversations with each)

5. Indian Point Units 2 and 3 ("Indian Point") are owned by separate limited liability corporations and are operated by Entergy Nuclear Operations, Inc.

6. Entergy has recently applied to the U.S. Nuclear Regulatory Commission for 20-year extensions of the original 40-year licenses for Units 2 and 3.

7. I am gravely concerned about the prospect of continued operations of Indian Point during a 20-year extension period.

8. I believe that Indian Point poses an unacceptable risk to my health and safety..

9. I believe that in the event of an accident or attack on Indian Point, I could become ill or die from radiological contamination.

10. If such an event required evacuation, I fear that I would not be able to evacuate safely because of the well-known traffic congestion on the major interstate highways near my home, I-95 and I-84, which in ordinary rush-hour conditions become seriously gridlocked.

11. I believe that on a daily basis Indian Point routinely releases radioactive effluent emissions into the air which are carried downwind and that as a consequence I am routinely subject to exposure to potent carcinogens which I cannot see, hear, feel or smell and therefore am helpless to protect myself against.

12. I am gravely concerned that such releases will increase during the projected license renewal period because of degraded plant conditions leading to increased

cracks and leaks.

13. I am gravely concerned about the cumulative effect of such radiation exposures and their long-term impact on my health and the health of my family, my friends, my community.

14. I am gravely concerned about the accumulation of deadly high-level radioactive waste and the continued production of such waste at Indian Point when there is to date no approved plan for treatment and/or disposal of such waste, which will remain deadly for thousands of years.

15. I act in this matter both as an individual and as designated representative for CRORIP.

Nancy Burton

OATH

I, Nancy Burton, having been duly sworn, do hereby declare that the statements set forth in the foregoing Affidavit are true to the best of my knowledge, information and belief.

STATE OF CONNECTICUT

ss: Redding

COUNTY OF FAIRFIELD

Sworn to and subscribed before me this 10th day of December, 2007.

Notary Public

My commission expires: _____

AILEEN NOSAL
NOTARY PUBLIC
MY COMMISSION EXPIRES NOV. 30, 2012

From: NancyBurtonCT@aol.com
Subject: **GAIL - SIGN THIS REVISED DECLARATION & FAX TO 203-938-3952 ASAP!!!!!**
Date: December 10, 2007 5:45:46 PM EST
To: gmerrill@optonline.net

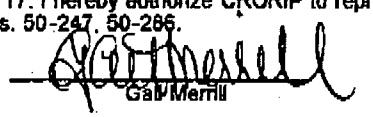
UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
Lawrence G. McDade, Chairman
Dr. Richard E. Wardwell
Dr. Kaye D. Lathrop

In the matter of DOCKET NOS.
ENTERGY NUCLEAR OPERATIONS, INC. 50-247-LR
(Indian Point Nuclear Generating Units 50-286-LR
2 and 3) December 10, 2007

DECLARATION OF GAIL MERRILL

Gail Merrill hereby declares under penalty of perjury that the following is true and correct:

1. My name is Gail Merrill.
2. I reside at 227 Silvermine Road in New Canaan, Connecticut.
3. My residence is located approximately20 miles or less from the Indian Point Nuclear Power Station in Buchanan, New York.
4. I am a member of Connecticut Residents Opposed to Relicensing of Indian Point (CRORIP").
5. At age 48, eight years ago, I was diagnosed with non-genetic breast cancer.
6. Through support groups and networking in the Fairfield County area near the New York border, I have become personally acquainted with dozens of young women who have been diagnosed with breast cancer.
7. Recently, three mothers in their 40s, all non-smokers, all died of lung cancer in my town.
8. I am aware of the case of a 19-year old woman with breast cancer, a 23-year-old young man with stage 4 prostate cancer, a 17-year-old boy with stage 3 non-Hodgkins lymphoma in Weston, Connecticut, a 10-year boy who died from leukemia also in Weston recently and the cases of two men with life-threatening end-stage lymphoma who reside in New Canaan. Everywhere I go in western Fairfield County, everyone is talking about the high incidence of cancer in our communities.
9. I am gravely concerned about the prospect of continued operations of Indian Point during a 20-year extension period.
10. I believe that Indian Point poses an unacceptable risk to my health and safety and my ability to carry on my business activities.
11. I believe that in the event of an accident or attack on Indian Point, I could become ill or die from radiological contamination.
12. If such an event required evacuation, I fear that I would not be able to evacuate safely because of the well-known traffic congestion on the major interstate highway near my home, I-95, which in ordinary rush-hour conditions becomes seriously gridlocked.
13. I believe that on a daily basis Indian Point routinely releases radioactive effluent emissions into the air which are carried downwind and that as a consequence I am routinely subject to exposure to potent carcinogens which I cannot see, hear, feel or smell and therefore am helpless to protect myself against.
14. I am gravely concerned that such releases will increase during the projected license renewal period because of degraded plant conditions leading to increased cracks and leaks.
15. I am gravely concerned about the cumulative effect of such radiation exposures and their long-term impact on my health and the health of my family, my friends, my community.
16. I am gravely concerned about the accumulation of deadly high-level radioactive waste and the continued production of such waste at Indian Point when there is to date no approved plan for treatment and/or disposal of such waste, which will remain deadly for thousands of years.
17. I hereby authorize CRORIP to represent my interests by intervening in the license renewal proceeding for Indian Point Units 2 and 3, Docket Nos. 50-247, 50-286.



Gail Merrill